

UNCLASSIFIED

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND



TECHNICAL REPORT

REPORT NO: NAWCADPAX/TR-2002/244

STEAM VAPOR CLEANING EJECTION SEAT FRAMES AND COMPONENTS TECHNICAL EVALUATION

by

**R. M. Kwan
A. J. Yost
J. V. Santiago
A. C. Herring
M. M. Conlin, STV Group**

19 March 2003

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DEPARTMENT OF THE NAVY
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND


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Head, In-Flight Escape Systems Branch
Naval Air Warfare Center Aircraft Division

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NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND



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SUMMARY

Current method of cleaning aircraft ejection seats consists of applying an organic solvent or Isopropyl Alcohol by brush or low lint cloth. This method of cleaning the ejection seat and/or ejection seat components is extremely labor-intensive and generates significant quantities of cleaning residue, which must be disposed of as HAZMAT.

An evaluation was performed using the Buddy Steamer System and Mini-Max Cleaning & Waste Management System® and the Arma-Sol® solutions. Both the Buddy and Mini-Max systems involved aqueous cleaning using steam-generation. The Buddy Steamer System was deemed unsuitable for our application and won't be considered further in this report.

Arma-Sol® is considered a good corrosion inhibitor but not a rust preventative. Corrosion prevention procedures must be implemented within 24 hr of Arma-Sol® application.

The steam vapor cleaning process is optimal when individual components are removed and/or disassembled as part of the normal task. This ensures that water is not trapped. Disassembly can be time and labor-intensive and is beyond Organizational level authority. It is part of the normal Intermediate and Depot level process. It is recommended that steam vapor cleaning not be authorized at the Organizational level, but it is strongly recommended for Intermediate and Depot level seat maintenance. The steam vapor cleaner will result in net annual savings of \$308,090 for the Navy.

Contents

	<u>Page No.</u>
Summary	ii
Notice	iv
Introduction	1
Problem Statement	1
Proposed Solution	1
Implementation Plan	2
Discussion	5
Organizational Level Maintenance Concerns and Comments	5
Intermediate/Depot Level Evaluation	5
Laboratory Analyses	7
Results	8
Conclusion/Recommendations	9
References	11
Appendices	
A. Mini-Max Cleaning Brochure	13
B. Safe Report of Steam Vapor Cleaning Egress Systems	31
C. North Island Test Plan	35
D. Steam Vapor Cleaning Evaluation Reports	39
E. Whidbey Island AIMD Visit Report	59
F. Materials Laboratory Report of Corrosion Resulting from	61
Steam Vapor Cleaning	
G. Materials Laboratory Report of O-Ring Deterioration from	77
Super Heated Steam	
Distribution	79

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1.0 INTRODUCTION

1.1 This report describes and documents the results of our Affordable Readiness Initiative to evaluate the steam vapor cleaning process on Navy ejection seats (reference 1).

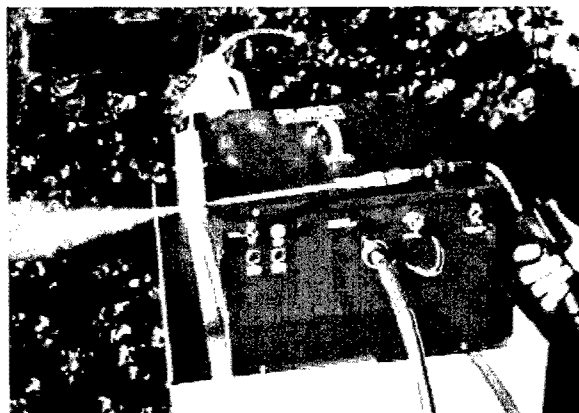
1.2 PROBLEM STATEMENT

1.2.1 Current method of cleaning aircraft ejection seats consists of applying an organic solvent or Isopropyl Alcohol by brush or low lint cloth. This method of cleaning the ejection seat and/or ejection seat components is extremely labor-intensive and generates significant quantities of cleaning residue, which must be disposed of as HAZMAT.

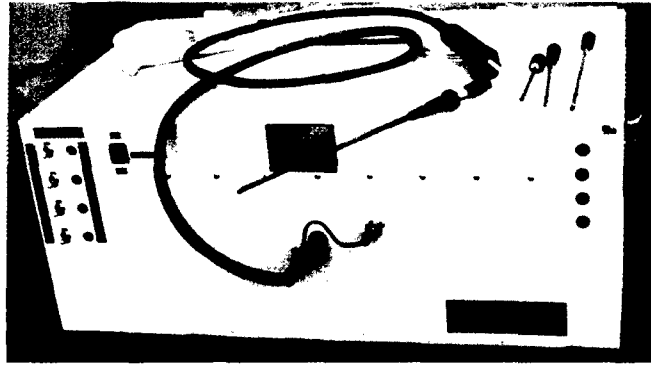
1.2.2 Each year, our naval industrial base is further restricted from using specific Ozone Depleting Substances (ODSs) used in the cleaning of aircraft parts. As a result, less effective means of cleaning components are usually implemented, almost invariably increasing labor/material costs and/or often decreasing the quality of the cleaned surfaces.

1.3 PROPOSED SOLUTION

1.3.1 Recommend investigation into the use of Mini-Max Cleaning & Waste Management System® manufactured by PDQ Precision, Inc. The system involves aqueous cleaning using superheated steam generated on-site via portable steam-generation units. Although PDQ Precision produces numerous models of the steam-generators (appendix A), there are three units that were included in the investigation. Two units are shown below:



190 PSI Standard Pressure Mini-Max Modular II, P/N 6609-2
295 PSI High Output Pressure Mini-Max Modular II, P/N 6609-22
(This is the same unit as above; however, it has a different pressure output)



295 PSI High Output Pressure Mini-Max Modular IV, Auto Version, P/N 6609-44A)

1.3.2 The Mini-Max Cleaners are excellent cleaners and degreasers and can remove oil, grease, sand, rust, carbon, burnt propellants, and/or flux. They are currently in use in the medical and automotive industries and are in limited use within the DoD (weapons and firearms cleaning).

1.3.3 The Mini-Max Cleaning & Waste Management System® provides the following potential benefits:

- a. Complete safety for the user and environment.
- b. Elimination or extreme reduction of solvent and HAZMAT disposal requirements.
- c. Equipment portability and flexibility in use.
- d. Cleaning without total disassembly.
- e. Cleaning in inaccessible areas.
- f. Minimal safety equipment requirements.
- g. Practically maintenance free.

1.3.4 Appendix B is a draft SAFE paper describing the steam vapor cleaning system to be presented at the September 2002 SAFE Symposium in Jacksonville, Florida.

1.4 IMPLEMENTATION PLAN

1.4.1 Purpose: To evaluate various aqueous cleaning systems on aircraft ejection seats/ejection seat components and nonejection seat components, using superheated steam from portable steam-generation units.

1.4.2 Portable Steam-Generation Units To Be Evaluated (appendix A):

- a. 1 each, Mini-Max Mod II 190 PSI, NSN 4250-01-470-7094.
- b. 1 each, Mini-Max Hand Held 190 PSI, NSN 4940-01-409-0148.
- c. 2 each, Mini-Max Mod II 295 PSI, NSN 4250-01-470-7091.
- d. 1 each, Mini-Max Mod IV 295 PSI, NSN 4250-01-470-7097.
- e. 1 each, Mini-Max Mod IV 190 PSI, NSN 4250-01-470-7095.
- f. 2 each, Buddy Steamer.

1.4.3 Evaluation Sites of Portable Steam-Generation Units:

- a. USMC Miramar, 1 each 190 PSI Hand Held, 1 each 295 PSI Mod II, and 1 each Buddy Steamer.
- b. Whidbey Island, 1 each 190 PSI Mod II and 1 each 295 PSI Mod II.
- c. NADEP JAX, 1 each 190 PSI Mod IV.
- d. NADEP NORIS, 1 each 295 PSI Mod IV.

1.4.4 Management of Portable Steam Vapor Cleaning Evaluation Program:

- a. Andy Herring is the project manager with oversight of the entire program.
- b. A. J. Yost is responsible for overall technical aspects of the program.
- c. Team members (Dennis Crowley, Ray Kwan, Jose Santiago, and Roger Grimes) assisted with the daily operations of the evaluation program.

1.4.5 Objectives of the Portable Steam Vapor Cleaning Evaluation Program

1.4.5.1 Establishment of effectiveness in terms of time and cost savings, improvements in cleaning effectiveness of the various steam vapor cleaning units. A test plan (appendix C) was prepared outlining the evaluation process.

1.4.5.2 Site Reports: Each site submitted weekly reports citing items cleaned, by what system, degree of success, observational comments, containers of solvent saved, and show cost/time savings on forms provided via Fax or E-mail (see Survey Form, appendix D).

1.4.5.3 Team members worked with the Depot shops and provided on-hands assistance.

1.4.5.4 Depot shops personnel were responsible for the annotation of the survey forms and the weekly submittal of the survey forms to on-site engineering.

1.4.5.5 NADEP Jacksonville engineering (Jose Santiago) ensured the accuracy and completeness of the survey forms submitted by NADEP Jacksonville personnel.

1.4.5.6 AIMD Whidbey Island ejection seat shop supervisor (Roger Grimes) ensured the accuracy and completeness of the survey forms by the AIMD personnel.

1.4.6 Program Evaluation Duration: The program started 1 May 2001 and ended 30 September 2001. Naval Message DTG 051944Z JUL 01 (reference 2) from NADEP Cherry Point authorized Organizational limited use of the steam vapor cleaning systems.

1.4.7 Items Evaluated:

- a. SJU17(V)-1/A, 2/A, 3/A, 4/A, 5/A, 6/A, and 9/A.
- b. SJU-5/A and 6/A.
- c. MK GRU7A-1 and 2.

- d. MK GRUEA 7 (PILOT, ECMO 1, 2, and 3).
- e. ESCAPAC 1E-1 (PILOT, COPILOT, SENSO, and TACCO).

1.4.8 Ejection Seat Areas and/or Components Not Authorized for Steam Vapor Cleaning

1.4.8.1 SJU17(V)-1/A, 2/A, 3/A, 4/A, 5/A, 6/A, and 9/A:

- a. Sequencer - shall not be subjected to steam vapor. Were removed prior to Main Beam cleaning.
- b. LH/RH Pitot Static Mechanism Assemblies - Pitot head orifices were plugged to prevent moisture intrusion. Also, applied tape to the Pitot Static Port on the main beam assembly to prevent moisture intrusion.

1.4.8.2 Shoulder Harness Reels were not subjected to steam vapor cleaning, except at a Depot, and were removed prior to Main Beam cleaning.

1.4.9 Protective Clothing Requirement:

- a. Water and heat repellant gloves.
- b. Goggles or face shield.
- c. Water and heat repellant apron.

1.4.10 Materials Required To Prevent Moisture Intrusion:

- a. Plugs used in orifice plugging.
- b. Tape (plater's or low adhesive).

1.4.11 Manuals Requiring Revision (if steam vapor cleaning is approved):

- a. NAVAIR 13-1-44.
- b. AS-700AC-MDB-000.
- c. NAVAIR 13-30-69.
- d. NAVAIR 13-30-41.
- e. NAVAIR 13-30GR-1.
- f. NAVAIR 01-1A-509.

2.0 DISCUSSION

2.1 ORGANIZATIONAL LEVEL MAINTENANCE CONCERNS AND COMMENTS

2.1.1 A 115 V, 30 amp power female receptacle is not available at most sites. A permanent female wall receptacle is needed which will increase the cost and infrastructure requirements. Mini-Max Cleaning & Waste Management System® comes supplied with proper female wall receptacles from the manufacturer. However, facilities must be wired to adapt to this female wall receptacle, thereby increasing labor costs.

2.1.2 It needs additional agitation/detergents to provide effective cleaning.

2.1.3 A 190 PSI unit is ineffective, awkward to use, and lacks endurance.

2.1.4 It is easy for inexperienced users to use tap water although warning decals can minimize problem.

2.1.5 Condensation formed on cleaning surface needs drying with shop filtered dry air, which may already be in place.

2.1.6 Gloves and PPE are required with QA/Safety Officer approval.

2.1.7 A 448-day inspection is the most suitable place for use of the steam vapor cleaner for the SJU-5/6 seats.

2.1.8 Loose paint will be removed and affected areas need to be treated in accordance with NAVAIR 01-1A-509.

2.1.9 Due to the fact that the majority of ejection seat maintenance is being performed prior to deployment, steam vapor cleaner use aboard ship was not evaluated.

2.1.10 Positive comments by Organizational level suggested additional uses such as aircraft panels, Environmental Control System (ECS) components, canopy brackets, ducting, and cockpits.

2.2 INTERMEDIATE/DEPOT LEVEL EVALUATION

2.2.1 Material Costs

2.2.1.1 NADEP North Island uses Isopropyl Alcohol to clean seat components. NAS Whidbey Island uses Toluene to clean tools and PD680 to clean seat components. The cost of materials is as follows:

Nomenclature	Cost	Quantity	NSN	Unit Price
Arma-Sol® Wash	\$379.20	100 gallons	6850-01-412-4364	\$3.79/gallon
Arma-Sol® Dry	\$379.20	100 gallons	6850-01-412-4375	\$3.79/gallon
Toluene	\$6.81	gallon	6810-00-281-2002	\$6.81/gallon
PD680	\$21.68	5 gallons	6850-00-274-5421	\$4.34/gallon
Isopropyl Alcohol	\$24.84	5 gallons	6810-00-855-6160	\$4.97/gallon

2.2.1.2 The Arma-Sol® solutions are available in concentrate form and premixed. The concentrate solutions need 1 gallon of distilled or deionized water to be added to form a useable liquid. The cost of water is considered negligible and is readily available in the Navy.

2.2.1.3 Appendix D shows the material cost savings as reported by the NADEP North Island, NADEP Jacksonville, and NAS Whidbey Island. The average component cost is \$1.37 to steam vapor clean, compared with \$2.60 using existing methods. Annually, the depots spend \$7,200 on cleaning solvents. Using the steam vapor cleaner, the depots would spend \$3,793, realizing an annual savings of \$3,406.

2.2.1.4 Components that are steam vapor cleaned do not require hazardous material disposal. It costs the depots \$14,000 annually to dispose of used chemicals. The only residue is solid waste that can be disposed of with other solid waste after the moisture evaporates.

2.2.1.5 The estimated total materials/disposal costs savings is \$17,406 annually.

2.2.2 Labor Man-Hour Savings

2.2.2.1 Appendix D shows the labor man-hour savings as reported by the NADEP North Island, NADEP Jacksonville, and NAS Whidbey Island. The average depot man-hour savings to steam vapor clean each component is 16 min compared to existing methods. The depots currently spend \$344,400 in labor costs annually cleaning. Using the steam vapor cleaner will result in \$254,400 annual savings.

2.2.2.2 The average Intermediate level man-hour savings is 60 min to steam vapor clean seat assemblies compared with existing methods. Additionally, it was reported that 2 hr of time was saved while cleaning tools. Annually, 400 seats are cleaned at Intermediate level for an annual savings of 400 Intermediate level man-hours. With a burdened man-hour cost of \$90.71, this translates into annual cost savings of \$36,284.

2.2.3 Depot and Intermediate Level Maintenance Concerns and Comments

2.2.3.1 Small parts were difficult to clean due to the difficulty of holding them. Using a mesh basket, the parts tended to blow around.

2.2.3.2 With filters installed in the spray booth fan exhaust, steam can build up inside the booth, obscuring vision.

2.2.3.3 Without detergent and physical brushing, cleaning was ineffective on extremely dirty surfaces.

2.2.3.4 Steam vapor cleaning is effective with use of detergent when cleaning larger components like a main beam assembly. However, water removal from external surfaces and orifices took considerable effort with dry shop air.

2.2.3.5 Condensation formed on cleaning surface requires drying with shop filtered dry air.

2.2.3.6 Intermediate level maintenance personnel are cleaning partially assembled seats with unauthorized components removed. The seat is too large to fit the spray booth, but cleaning can be done on the shop floor. Cleaning was effective with enormous time-savings over existing cleaning methods. Appendix E documents how the Intermediate level maintainers use the steam vapor cleaner.

2.2.4 Navy Aircrew Common Ejection Seat (NACES) Component Evaluation

2.2.4.1 In-service Management Panel (IMP) exhibited no internal moisture upon disassembly after steam vapor cleaning.

2.2.4.2 Moisture was found inside the Barostatic Release Unit (BRU) after steam vapor cleaning. O-rings appeared to be in normal condition, although water droplets were present. Lubricated surfaces appeared unaffected by steam vapor cleaning process.

2.2.4.3 The catapult manifold valve exhibited internal moisture upon disassembly after steam vapor cleaning.

2.2.4.4 The pitot tube showed extensive moisture in the static port screen, but no moisture was found in the other internal areas.

2.3 LABORATORY ANALYSES

2.3.1 Corrosion

2.3.1.1 Materials laboratory testing was performed at NADEP North Island, California, to independently verify effectiveness of the Arma-Sol® solution as a rust inhibitor. The testing was performed as follows:

- a. Seven identical bare 4120 steel plates were Garnet blasted and rinsed in alcohol. Five were subjected to exposure in heated deionized water or heated deionized water with Arma-Sol® rust inhibitors. One of the remaining plates was immersed for 2.5 min in deionized water with Arma-Sol® dry solution and the other with Arma-Sol® wash.

- b. The two bare plates, which were exposed to deionized water, had visible pitting after 10 min. The plate that was immersed in the 160-deg water had a band of pits along the lower edge where remaining water was held by surface tension. The plate exposed to 200-deg water did not retain any liquid water along the lower edge; therefore, there was no band of pits at this location. The plates exposed to water solution with Arma-Sol® did not display pit initiation until 24 hr later.

2.3.1.2 Arma-Sol® does appear to provide a limited temporary protection against flash corrosion compared to deionized water. Arma-Sol®, wash and dry types, should be used in the steam vapor cleaner as a temporary corrosion inhibitor. After steam vapor cleaning, corrosion treatment should be performed within 24 hr in accordance with NAVAIR 01-1A-509. Appendix F provides more details of the corrosion testing.

2.3.2 O-Ring Deterioration

2.3.2.1 Appendix G documents the laboratory testing of potential deterioration of the O-rings from the super heated steam. The Materials Laboratory at NADEP Jacksonville has stated that the heat generation of 300°F, in the steam vapor cleaning process, will neither accelerate deterioration nor damage O-rings used on Navy ejection seats. The O-rings in question, MS28775 and MS29513, are rated at a 275°F maximum temperature allowed. These O-rings are now superseded by SAE-AS28775 and SAE-AS29513, respectively, but specification requirements remain the same. The steam vapor cleaning process will, however, remove any MIL-PRF-32033 lubricant, which supersedes the VV-L-800 lubricant, exposed to the steam spraying action. Required lubricant will need to be replaced after cleaning.

3.0 RESULTS

3.1 At the conclusion of the steam vapor cleaning process/equipment evaluation, it was deemed that five of the six models procured were inadequate for the particular application. It was found that this equipment did have qualities that would prove beneficial to a wide range of aircraft platforms. The one model that proved to be sufficient in all categories was the 295 PSI Modular IV, built by PDQ Precision Inc. The other models lacked sufficient pressure or did not provide continuous pressure, which called for a short, stand-down period, until the pressure built back up. Further, it was deemed necessary for this steam vapor cleaning process/equipment to be used only by the Intermediate and Depot level of maintenance. This is due to the fact that water intrusion is imminent and repair/overhaul can only be performed at these levels. Finally, it was found that, after using this cleaning method, corrosion prevention procedures must be implemented immediately, if a corrosion inhibitor is not used. If an inhibitor is used, then corrosion prevention procedures must be performed within 24 hr.

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Water entrapment limits usefulness of the steam vapor cleaning process. The steam vapor cleaning process is optimal when individual components are removed and/or disassembled as part of the normal task. This ensures that water is not trapped. Disassembly can be time and labor-intensive and is beyond Organizational level authority, but it is part of the normal Intermediate and Depot level process. It is, therefore, recommended that steam vapor cleaning not be authorized at the Organizational level. It is, however, strongly recommended for Intermediate and Depot level seat maintenance. It was also noted that the steam vapor cleaning process could be useful for nonegress aircraft applications such as aircraft panels, ECS components, canopy brackets, ducting, and cockpits.

4.2 As reported by NADEP North Island Materials Lab, Arma-Sol® is considered a good corrosion inhibitor but not a rust preventative. Corrosion prevention procedures must be implemented within 24 hr of Arma-Sol® application. If Arma-Sol® solution is not used, corrosion prevention procedures must be implemented immediately in accordance with the applicable maintenance instructions.

4.3 Limits on the use of steam vapor cleaning on ejection seat components for Intermediate and Depot level process will be issued via changes in the applicable Intermediate and Depot level manuals and/or instructions.

4.4 Cost benefits: The steam vapor cleaner will result in net annual savings of \$308,090 for the Navy.

ANNUAL SAVINGS

Material Savings	\$3,406
Hazardous Material Savings	\$14,000
Depot Labor Savings	\$254,400
<u>Intermediate Level Labor Savings</u>	<u>\$36,284</u>
Total Savings	\$308,090

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REFERENCES

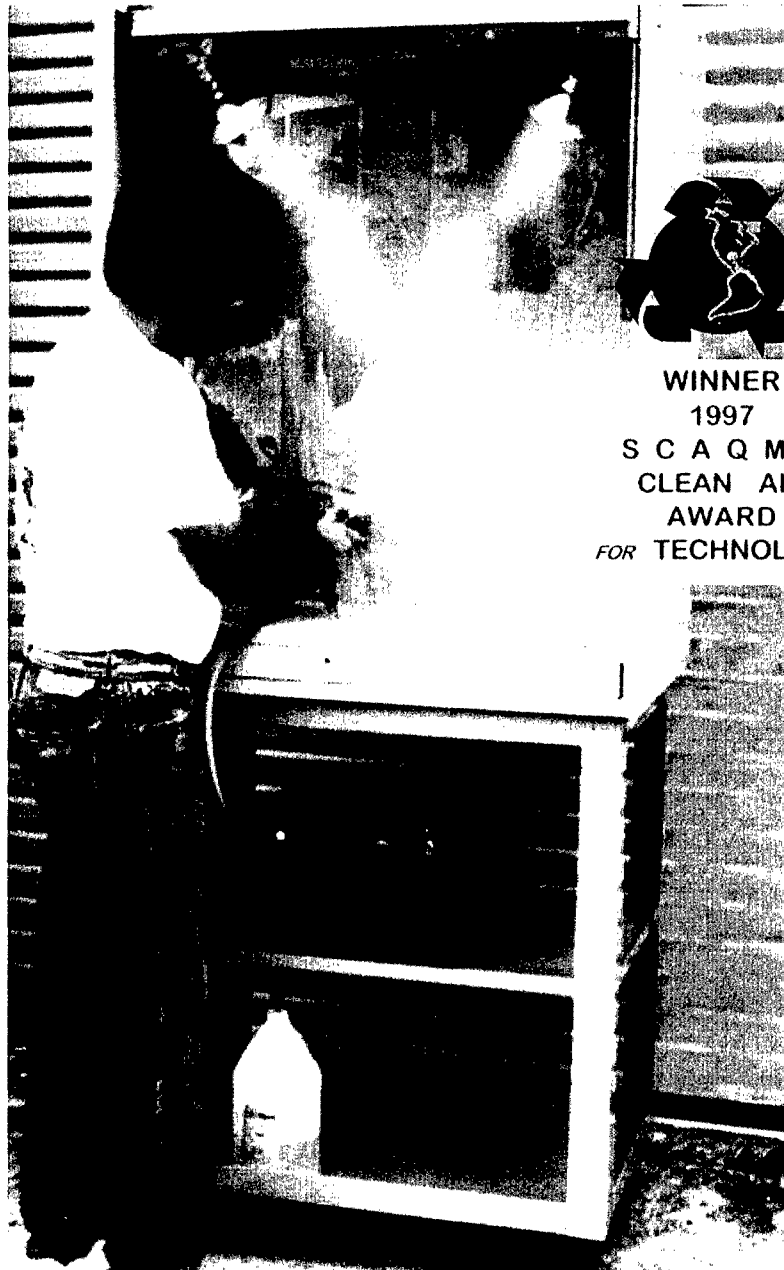
1. O&M, N Affordable Readiness/Total Ownership Cost Reduction Initiative (FY01-FY03, NAVAIR ID#: 01-1-202-006, of Jan 2001.
2. NAVAIRDEPOT CHERRY POINT NC msg dtg 051944Z JUL 01.

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APPENDIX A
MINI-MAX CLEANING BROCHURE

COPY

**MINI - MAX CLEANING
&
WASTE MANAGEMENT SYSTEM ®**



**WINNER
1997
S C A Q M D
CLEAN AIR
AWARD
FOR TECHNOLOGY**

AQUEOUS YET WATERLESS CLEANING™

COPY

COPY



MINI - MAX CLEANER® is a *patented* process which instantly converts clean water to high pressure steam vapor on demand and is easily controllable by the operator. ARMA - SOL® rust inhibitor is added when required for corrosion control.

Steam, the combination of moisture, heat and pressure provides the means for immediate removal of contaminants from a given surface, cleaning it thoroughly, coupled with immediate spotless drying.

By activating the hand or foot operated switches, the operator activates our special pump which injects a metered amount of liquid into the patented Mini - Max Cleaner® chamber. This fluid converts into high pressure vaporized steam instantly, discharging forcibly through the nozzle or wand assembly outside the cabinet.

The plastic hose pickup tube is inserted into any size container of liquid. The Mini - Max Cleaner® draws what it needs to make high pressure steam vapor.

The Mini-Max Enhanced Cleaning Systems demand that only clean water such as distilled or deionized or otherwise properly filtered water be used. Ordinary tap water with its impurities and solids can contaminate the cleansing steam vapor and may require needless maintenance on the Mini-Max Cleaner®.

Where there are rustable parts being cleaned, to prevent rust formation, we recommend the use of ARMA - SOL® rust inhibiting solution.

The design of the Mini - Max Cleaner® is completely safe because no steam is stored under pressure as in conventional steam boilers.

All models are designed with attributes to offer standard 190 PSI or High Output 295 PSI of pressure as well as the various ways to deliver. From the basic table top unit to the Hand Held System's ability to bring the cleaner to the cleaning site, be it under, up or around with complete flexibility. From timed bursts of pressure to the continuous, perpetual "Day and Night" high pressure steam vapor for as long liquid is provided.

The Waste Management System® can be utilized with any of the Mini-Max Cleaner® models.

FED. I.D. # 33-0127037

GSA CONTRACT # GS-07F-5805A

CAGE CODE: 0AN51

D.U.N.S.# 17-533-0620

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MINI - MAX CLEANER ®
With
ARMA - SOL ®
The Aqueous yet Waterless Cleaning System™

FACT SHEET



1. www.minimaxcleaner.com PLEASE VISIT US !
2. MINI - MAX Cleaners are never obsolete and can be upgraded to today's state of the art pressure and improved longevity.
3. All the Mini-Max Cleaners; can be covered by our extended maintenance contracts at very reasonable costs.
4. Our base pressure output is 190 PSI for all our models. Our High Output models operate at 295 PSI and they can be had to operate automatically and continuously.
5. GSA Contracts for all models and NSN for most items.
6. Since 1980, track record of safe, reliable performance.
7. Endorsed by U.S. NAVY P2 FASTT, U.S. AIR FORCE MEEP, and Industry in almost all areas of cleaning. Winner 1997 AQMD Clean Air Award FOR Technology.
8. The most cost effective cleaning systems available today !
9. All models are excellent degreasers and can remove oil, grease, sand, rust, carbon, fouling, burnt propellant, flux, etc.

WE DO NOT HAVE

Solvents or alternatives.
Waste water streams.
Ongoing costs of chemicals.
The need for purging the equipment of consumed waste.
Costs for waste disposal.
High power consumption cost.
Plumbing requirements.
High equipment maintenance costs.
The hazards of hot liquid splashing.
The need of user respirators, the protection required, should be based on the contaminants being removed.
EPCRA reporting, ETC.

WE DO HAVE

Complete safety for the user and environment.
Elimination or reduction of solvents.
Equipment portability and flexibility in use.
Cleaning without total disassembly.
Cleaning in inaccessible areas.
Minimal safety equipment requirements.
Practically maintenance free.

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3

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MINI - MAX WASTE MANAGEMENT SYSTEM™



**NO WASTE WATER STREAM
NO SOLVENTS
SEE -THRU CURTAINED DOOR
PROTECTS OPERATOR
CABINET'S CORNERED LEGS FIT
SNUGLY INTO THE CART OR CAN
ALLOW IT TO STAND ALONE
ENVIRONMENTALLY FRIENDLY
ENTIRE UNIT IS PORTABLE
SAFE FOR ALMOST ANYTHING
TRAPS AND CONTAINS ALL
RESIDUE IN REPLACEABLE
ABSORBENT PADS
CAN BE USED WITH ALL
MINI - MAX CLEANER® MODELS**

Shown Above with Modular II™ High Output
But system works with all models Mini - Max Cleaner®

GSA CONTRACT: # GS-07F-5805A

Waste Management Cabinet Stock No. 6609-50

CABINET: Steel 42"H 36" W 24" D Powder Coated Total Weight 100 LBS.
DRIP DRAWER: For Waste Containment 2" H 33" W 23" D
LOAD ENTRANCE: Curtained door swings open for loading 36" H 34" W
VINYL CURTAINS: Clear See - Thru overlap panels exhaust. 33" H 36" W
4 EXHAUST FANS: 4.5" diameter with clean able filter.
SPOTLIGHTS: Two all weather fixtures
POWER SWITCH: All weather fixture.
WORK TABLE: Expanded metal on reinforced frame.
POWER: 115 V. AC
U.S. PATENT PENDING

Mini - Max Portability Cart™ Stock No. 6609-5

Welded Steel 37" H 36" W 36" D Weighs 55 pounds Powder Coated 3 Shelves
100 ft Power Cord on reel All weather dual electrical receptacle Casters with individual locks

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4

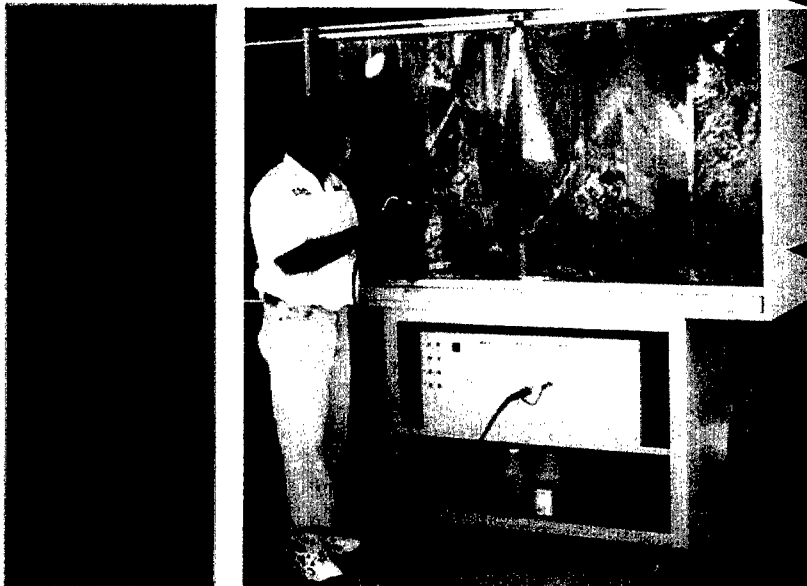
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MINI - MAX WASTE MANAGEMENT SYSTEM™

JUMBO MODEL



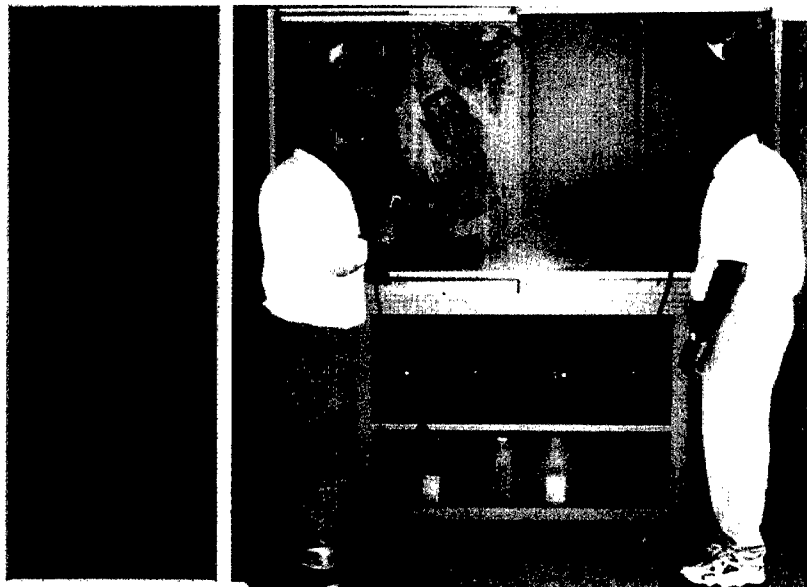
**4 EXHAUST FANS
LOCATED ON TOP**

**2 FLOOD LIGHTS
PROVIDE AMPLE
LIGHTING**

**WASTE MANAGEMENT
CABINET**

PORTABILITY CART

WASTE MANAGEMENT SYSTEM PICTURED ABOVE
IS SHOWN WITH THE MINI - Max MODULAR IV™



**JUMBO
WASTE MANAGEMENT
CABINET**
STOCK NO. 6609 - 72
115 V AC
72" L 23" D 42" H

**JUMBO
PORTABILITY CART**
STOCK NO. 6609-48
48" L 22" D 36" H

ACCESSORIES
Stock No.
6609-50AB
10 PACK REPLACEMENT
ABSORBANCY PADS

6609-50F
EXHAUST FAN FILTERS

WASTE MANAGEMENT SYSTEM™ SHOWN WITH 2 MODULAR II SYSTEMS

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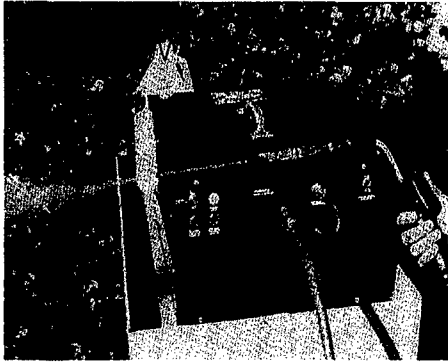
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190 PSI Standard Pressure Models



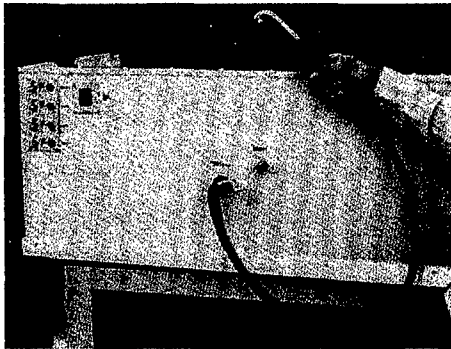
MINI - MAX MODULAR II™
Stock No. 6609-2
GSA # GS-07F-5805A

Mini - Max Modular II™

- ⇒ EIGHT TO TEN MINUTE WARM - UP
- ⇒ MODULAR II™ GIVE 190 PSI FOR ABOUT 15 TO 20 MINUTES (two minute recovery if unit cools down)
- ⇒ RECOMMENDED FOR MODERATE TO HEAVY VOLUMES OF CLEANING & DEGREASING & DECONTAMINATION

SPECIFICATIONS

Steel Powder Coated Cabinet 16" W 14" D 9" H
Weight 32 Pounds
Power 115 V 20 A 2400 W
Output 190 PSI Steam Vapor
Warranty 1 Year
UL APPROVED
230 V AVAILABLE



Mini - Max Modular IV™
Stock No. 6609-4
GSA # GS-07F-5805A

MINI - MAX MODULAR IV™ CLEANER

- ◆ ALL TIMING CONTROLS LOCATED OUTSIDE CABINET
- ◆ CONTINUOUS HIGH PRESSURE SUPER HEATED STEAM VAPOR FOR HEAVIER VOLUMES OF WORK LOAD
- ◆ PROVIDES CONSTANT 190 PSI STEAM PRESSURE
- ◆ PERFECT FOR CLEANING & DEGREASING &

SPECIFICATIONS

Steel Powder Coated Cabinet 35" W 16" D 16" H
Weight 115 Pounds
Power 230 V 26 A 6000 w
Output 115V 26A 6000W Per separate dual circuits
Warranty Continuous 190 PSI Steam Vapor
Startup 1 Year
6 to 8 Minutes

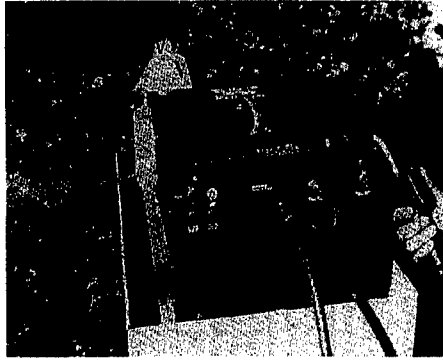
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6

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Mini - Max Modular II™
HIGH OUTPUT
 Stock No. 6609-22
 GSA # GS-07F-5805A

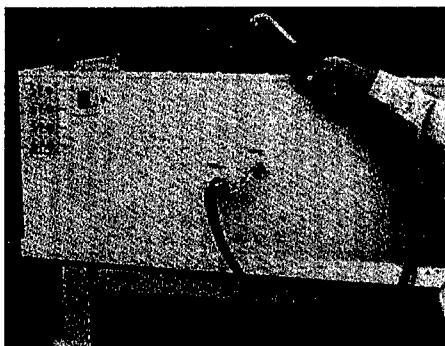
Mini - Max Modular II™
HIGH OUTPUT

- ◆ EIGHT TO TEN MINUTE WARM - UP
- ◆ 295 PSI FOR ABOUT 7 TO 10 MINUTES
(COOL DOWN ? TWO MINUTE RECOVERY !!!)
- ◆ PERFECT FOR WEAPON CLEANING
- ◆ EXCELLENT FOR DIFFICULT
DEGREASING & CONTAMINANT
REMOVAL

SPECIFICATIONS

Steel Powder Coated Cabinet	16" W 14" D 9" H
Weight	32 Pounds
Power	115 V 20 A 2400 W
Output	295 PSI Steam Vapor
Warranty	1 Year
<i>UL APPROVED</i>	

230 V AVAILABLE



Mini - Max Modular IV™
HIGH OUTPUT
 Stock No. 6609-44
 Controlled burst
 via switch in wand assembly

Mini - Max Modular IV™
HIGH OUTPUT
 Stock No. 6609-44A
 Auto version electronically controlled
 GSA # GS-07F-5805A

MINI - MAX MODULAR IV™ CLEANER
HIGH OUTPUT

CHOICE OF 2 MODELS

- ◆ IDEAL FOR DEGREASING &
DECONTAMINATION
- ◆ HIGH PRESSURE SUPER HEATED STEAM
VAPOR FOR HEAVIER VOLUMES
OF WORK LOAD
- ◆ PROVIDES 295 PSI STEAM PRESSURE
continuously So long as liquid is provided.

SPECIFICATIONS

Steel Powder Coated Cabinet	35" W 19" D 16" H
Weight	115 Pounds
Power	230 V 26 A 6000 W
Output	295 PSI Steam Vapor
Warranty	1 Year
Startup	6 to 8 Minutes

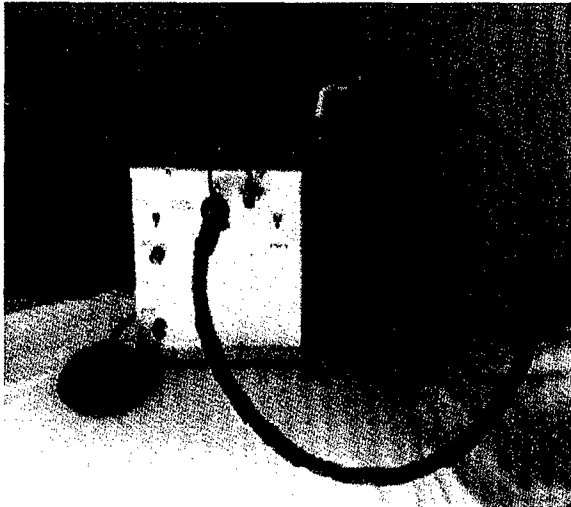
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Item No. 6606
 NSN # 4940 01 411 8632
 GSA Contract # GS-07F-5805A

MINI - MAX CLEANER ®

- Recommended for small parts cleaning & degreasing.
- From weapons to electronics
- 6 Minute warm-up.

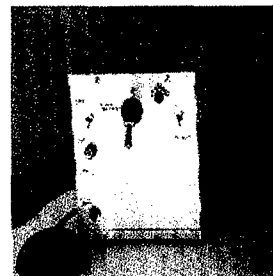
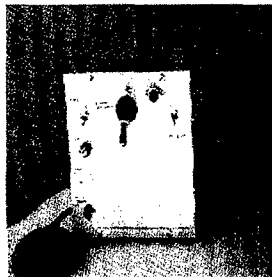
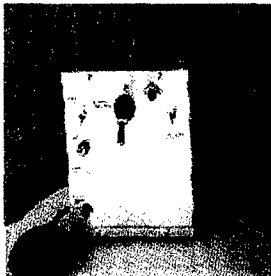
All come with removable nozzles and can be activated with manual or foot switches. Cleans & degreases small parts, electronics, circuit boards, flux removal etc.

USE **ARMA - SOL ®** AS RUST INHIBITOR WHEN REQUIRED

U L Approved

SIZE: 7" W 11" D 8" H
 WEIGHT: 18 LBS
 SHIPPING WT: 20 LBS
 LIQUID CAPACITY: UNLIMITED

STEAM PRESSURE with nozzle	150 PSI
STEAM PRESSURE with wand	190 PSI
POWER:	115 V 13 A 1500 W
	(230 Volts Available)

MINI - MAX SMALL ARMS ROOM CLEANING SYSTEM™

Designed to clean & degrease all small bore weapons. Using unit #2 as a back-up for unit #1, using Arma - Sol ® Wash, rust inhibitor with detergent (Stock #6600-91); while unit #1 recovers temperature (2 minutes) complete cleaning with unit #2. Machine #3 uses Arma-Sol ® Dry (Stock #6600-9) to finish cleaning the item antiseptically and remove any remaining contaminants leaving a hot surface to apply final lube when required.

3. Machine system as shown above Stock number: 6606-109

Note: Two machine system can work when weapon count is small.

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MINI - MAX HAND HELD CLEANING SYSTEM TM
190 P S I FOR CLEANING & DEGREASING & DECONTAMINATION
PORTABILITY OVER A WIDE AREA. > > FLEXIBILITY TO A 50' RADIUS

Stock No. 6606-21 Total System NSN# 4940 01 409 0148

Complete work station consists of the following: 6606-203, 6606-203-1, 6606-25

GSA Contract # GS-07F-5805A



EACH CHAMBER
115 V 13 A 1500 W
230 V AVAILABLE

MINI - MAX Hand Held System TM

Stock No. 6606-203

NSN # 4940 01 411 3278

- ⇒ CENTRAL PUMPING STATION
- ⇒ 2 SEPARATE STEAM VAPOR GENERATORS, EACH OPERATING INDEPENDENTLY
- ⇒ 2 ELECTRIC FOOT SWITCHES
- ⇒ 2 PLAIN NOZZLES
- ⇒ 2 SETS RIGID WAND EXTENDERS FOR THEM-2 AND M-60 BARRELS
- ⇒ 2 SETS OF 13' UMBILICAL LINES CONNECTING THE GENERATORS TO THE PUMPING STATION

MINI - MAX Rigid and Flexible Wand Accessories

Stock No. 6606-203-1

NSN # 4940 01 414 1565

PICTURE SHOWS HAND HELD SYSTEM TM AS ABOVE WITH THE TWO SETS OF FLEXIBLE WAND ASSEMBLIES AND THEIR RIGID WAND ACCESSORIES.

SEE ITEM 6606-42MA ON THE ACCESSORY PAGE FOR DETAILS.



MINI - MAX MOBILE CART TM

Stock No. 6606-25

NSN # 4940 01 411 3280

- ⇒ THREE TIERED WITH INDIVIDUALLY LOCKING WHEELS
- ⇒ 100' ELECTRICAL EXTENSION CORD ON REEL
- ⇒ DOUBLE ALL WEATHER OUTLET RECEPTACLE
- ⇒ STORAGE AREA IN PLACE FOR THE RIGID WANDS

NEW ITEM

Item No. 6606-203-2

NSN # 4940 01 414 1566

Dual Activator Flex Wand 8 ft. long with manifold and wide flat spray extender.

Lets you get the output of two hand held units at the same time.

WORKING VAPOR PRESSURE JUMPS FROM 190 PSI TO 295 PSI.

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Stock No. 6606-6
 NSN No: 4940 01 409 0149
 GSA Contract # GS-07F-5805A

This unit is delivered complete with 42" length wand and a water pumping and Ion filtering system for field use anywhere. This system can be used with jumper cables or with NATO Adapters to attach to the slave cable for use in vehicles, aircraft, etc. 25' of Plastic tubing supplied to be placed into any lake or stream, is pumped through our filter and cleansed then into a container for storage from which the Mini - Max Cleaner® draws it's liquid.

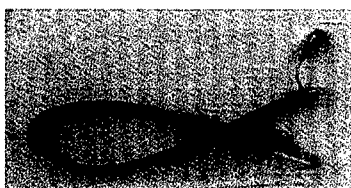
Specifications

Mini - Max Cleaner®	7" W 11" D 8" H
Pumping Station:	6" W 7" D 8" H
Steam pressure with wand:	190 PSI
Power:	24 Volt DC
Total combined wt.:	30 Lbs.

ACCESSORIES

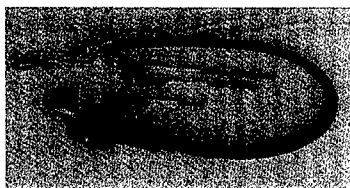
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Item No. 6606-42 NSN 4940 01 411 3193 Flex Wand 42" No switch.

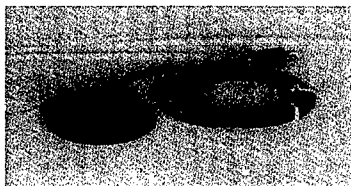


FLEXIBLE WAND ATTACHMENTS With Switch in Handle

- ↔ 6606-42M NSN# 4940 01 411 8737 42" Length hose.
- ↔ 6606-96M NSN# 4940 01 414 1561 96" [8'] Length hose



- ↔ 6606 - 42MA NSN# 4940 01 411 8735
42" Hose length with 3 Snap - on accessories
- ↔ 6606 - 96MA NSN# 4940 01 414 1563
96" [8'] Hose length with 3 Snap - on accessories



ELECTRIC FOOT SWITCH

6606 - 3 NSN# 4940 01 411 8642
 Replacement Foot Switch

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10

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ARMA - SOL[®]

Rust Inhibitor

**THE ONLY RECOMMENDED
SOLUTION FOR USE WITH THE
MINI - MAX CLEANER[®]
SYSTEMS**



**South Coast
Air Quality Management District**
21865 E. Copley Drive, Diamond Bar, CA 91765-4182
(909) 396-2000 • <http://www.aqmd.gov>

September 3, 1997

Mr. Jose B. Gonzales
FTC
1165 Walnut Avenue
Chula Vista, CA 91911

Subject: Clean Air Solvent (CAS) Certification

Dear Mr. Gonzales:

CONGRATULATIONS

Your submitted product(s) have successfully met all of the requirements for a Clean Air Solvent Certificate from the South Coast Air Quality Management District (AQMD). The Certification will be valid for five (5) years from the date of issuance and may be renewed upon recertification by the AQMD. The following product(s) will be classified as a CAS(s) by the AQMD:

- Arma - Sol Dry Concentrate

Clean Air Solvent (CAS) eligibility determination by SCAQMD Method 313-91. All Analyses were performed on the product as received.

There were no VOHAP, ODC, GWC, or VOC Detected.

CONCLUSION: THE PRODUCT MEETS CAS CRITERIA.

Prepared Solutions in one gallon plastic bottles PACKAGED 4 GALLONS PER CASE

# 6600-9	ARMA - SOL [®] DRY SOLUTION	[YELLOW LABEL]	NSN# 6850 01 412 4360
# 6600 - 91	ARMA - SOL [®] WASH SOLUTION	[GREEN LABEL]	NSN# 6850 01 412 4372

CONCENTRATES OF ARMA - SOL[®] Add One Bottle per Gallon Distilled Water

# 6600-7	DRY SOLUTION 100 count case	NSN # 6850 01 412 4375
# 6600-71	WASH SOLUTION 100 count case	NSN # 6850 01 412 4364
# 6600-7A	DRY SOLUTION 10 Pack	NSN # 6850 01 412 4373
# 6600-71A	WASH SOLUTION 10 Pack	NSN # 6850 01 412 4374

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11

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WARRANTY

THE **MINI - MAX CLEANER®** IS GUARANTEED TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP FOR ONE YEAR FROM DATE OF PURCHASE. ANY DEFECTIVE PART WILL BE REPAIRED OR REPLACED AT OUR OPTION, PROVIDING THE **MINI - MAX CLEANER®** SHOWS NO SIGN OF MISUSE OR ABUSE.

IF REPAIR IS NECESSARY, RETURN THE **MINI - MAX CLEANER®** FREIGHT PREPAID TO:

**PDQ PRECISION INC.
1165 WALNUT AVENUE
CHULA VISTA, CA 91911**

BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

NAME, ADDRESS, TELEPHONE, AND A BRIEF DESCRIPTION OF THE PROBLEM.

THIS WARRANTY DOES NOT APPLY TO ANY MINI - MAX CLEANER® SUBJECT TO DAMAGE BY ABUSIVE HANDLING OR MISUSE.

WARRANTY EXTENSION PROGRAMS AVAILABLE ALL MODELS.

CONTINUE THE ANNUAL WARRANTY WITH OUR EXTENDED MAINTENANCE
PROPOSAL FOR ALL MINI-MAX CLEANERS AND ACCESSORIES

PUMPS SERVICED, RINGS REPLACED
VAPOR CHAMBERS CLEANED, INSPECTED, RECHARGED
ELECTRONICS TESTED, ADJUSTED WHERE NEEDED
ACCESSORIES, WANDS, REPAIRED AS NEEDED
QUICK DISCONNECTS RE-RINGED
REPAIR, REPLACE ANY COMPONENTS SHOWING WEAR

EXTEND THE LIFE OF YOUR EQUIPMENT FOR YEARS
SEND FOR COPY OF CONTRACT

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DECONTAMINATION RECOMMENDATION

WITH CHEMICAL AND GERM WARFARE A POSSIBILITY, BE IT ACTUAL WAR OR A SNEAK ENCOUNTER THE NEED TO DECONTAMINATE MACHINERY EQUIPMENT AS WELL AS THE PEOPLE AFFECTED BY SUCH ACTIONS IS OF VITAL IMPORTANCE.

MOVING PEOPLE AND THINGS TO DECONTAMINATION SITES MAY BE DIFFICULT AND MAYBE IMPOSSIBLE, AND AT SUCH SITES THE RETRIEVAL OF THE AGENT AND THE REMOVAL LIQUIDS IN ITSELF CAN BECOME A STAGGERING BURDEN.

CONSIDER IF YOU WOULD, THE MINI-MAX CLEANING SYSTEMS, PORTABLE AND EASILY, QUICKLY PUT INTO USER CONFIGURATIONS OF SPRAY ATTACHMENTS FROM SIMPLE HOSE TO CIRCULAR SHOWER TYPES CAN BE UTILIZED TO DELIVER THE MINI-MAX RINSING VAPOR SPRAYS.

SINCE WATER IS THE PRIME CLEANING AGENT FOR THE MINI-MAX SYSTEMS, AND STEAM VAPOR THE ACTUAL CLEANER. DEPENDING UPON THE SITUATION AND CIRCUMSTANCES INVOLVED, PICTURE SPRAYING THE CONTAMINATED WITH WHATEVER CHEMICAL DECONTAMINANT MAY BE CALLED FOR. THEN WASH IT ALL DOWN INTO A SIMPLE BUCKET, TUB OR TARP. WITH THE STEAM VAPOR EVAPORATING, THE ONLY RESIDUE WOULD BE THE CONTAMINANT AND OR CONTAMINANT REMOVAL AGENT TO DISPOSE OF. THERE IS NO WASTE WATER STREAM.

LIQUID DECONTAMINATION CHEMICALS WHICH DO NOT HAVE A FLASH POINT CAN BE APPLIED VIA THE WATER SUPPLY THROUGH THE MINI-MAX CLEANERS SAFELY AND EFFICIENTLY.

**ALTERNATE PURCHASE PLANS
ARE AVAILABLE**

R EQUIPMENT LEASING

R EQUIPMENT RENTAL

SHORT TERM (6 MONTH)
LONG TERM (12 month)

R PURCHASE

SHORT TERM > INTEREST FREE



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U.S. NAVY: FASTT REPORT:

VIABLE ALTERNATIVE TO REPLACE SOLVENT CLEANING AND
DEGREASING OF WEAPONS, AUTOMOTIVE PARTS, ELEC-
TRONICS, PRINTED CIRCUIT BOARDS, GROUND SUPPORT
EQUIPT. AND OTHER GEAR.

ECONOMIC ANALYSIS: MINI-MAX VS. SOLVENTS:

SUMMARY:

ANNUAL SAVINGS, MINI-MAX **\$ 383,146**

CAPITAL COST: **\$ 8,324**

PAYBACK: **ONE YEAR**

NSWC CRANE DIV. REPORT:

EVALUATION: HAWK (GSE)

CORROSION CONTROL PROGRAM:

RESULTS: TEN MOTHER BOARDS & 26

INTERFACE CARDS CLEANED WITHOUT DAMAGE.

FAILURES DUE TO ESD: **NONE**

FAILURES DUE TO EXCESSIVE HEAT: **NONE**

JOBYHANNA ARMY DEPOT

THE MINI-MAX IS USED TO CLEAN PRINTED CIRCUIT
BOARDS, POWER SUPPLIES, BACK WIRING, HARNESSSES,
CABLES, MODULES, CHASSIS HARDWARE, TEST SETS,
TRANSPONDER AND INTERROGATOR SETS ETC. IT HAS
PROVED TO BE ENVIRONMENTALLY SAFE AND A TIME
SAVER.

**REPORT : AIMD SAN DIEGO,
US NAVY:**

CLEANS A MYRIAD OF SMALL PARTS THAT HERETOFORE
DEEMED DIFFICULT IF NOT VIRTUALLY IMPOSSIBLE TO
CLEAN

EVALUATION MARINES:

CLEANING THEIR WEAPONS HAS NEVER BEEN EASIER.
ENTIRE INVENTORY OF WEAPONS NOW CLEANED IN DAYS
NOT WEEKS.

AIMD POWER PLANTS: EFFECTIVE GETTING INTO SMALL
AREAS ON THE TURBINE ENGINE. THE MINI-MAX
PERFORMED AS ADVERTISED.

SUMMARY: VERY EFFECTIVE TIME SAVING EQUIPMENT
WHEN PROPERLY USED IN APPLICATIONS IT IS DESIGNED
FOR. ELIMINATES THE NEED TO DISASSEMBLE, REDUCES
CLEANING TIME UP TO 60 %.

**USMC: PAX RIVER TO ASST DPTY.
SECT/NAVY
SAFETY AND SURVIVABILITY**

THE MARINES WERE IMPRESSED - CUT WORK TIME IN
HALF. ARMA-SOL RUST INHIBITOR HELPED PREVENT
WEAPONS FROM RUSTING.

RESULT: MORE CONSTRUCTIVE TRAINING SCHEDULE.

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14

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NAF EL CENTRO, CA TEST RESULTS:

WASTE MANAGEMENT:

DISPOSAL COSTS NORMALLY: 4 DRUMS
AIRCRAFT CLEANER / WATER: IN 2 WEEKS
COST \$360.00. With Mini-MAX WASTE DISPOSAL
SYSTEM REDUCED TO TWO PIG MATS, DISPOSAL COST
ABOUT .80 CENTS EVERY TWO WEEKS.
PARTS CLEANED: TIME CUT FROM 4 HOURS TO 1.5 HRS
PER 100- PARTS AND CLEANED FAR BETTER THAN BY
HAND.
NO SOAKING, WE CLEANED IMMEDIATELY.
AIRCRAFT CLEANER ELIMINATED.
MINI-MAX WATER USAGE RATE: 1 GAL PER 8 HOURS OF
CONTINUOUS CLEANING.

**IN USE AT HOME AND ABROAD
BY UNITS OF THE U.S. ARMED
FORCES:**

UNITED STATES AIR FORCE
UNITED STATES NAVY
UNITED STATES MARINES
UNITED STATES ARMY
UNITED STATES NATIONAL GUARD
U.S. SPECIAL FORCES

COMMERCIAL IN USE BY MANY OF THE GOVERNMENT
CONTRACTORS AS WELL AS MANY MAJOR CORPORATIONS

LET'S NOT LEAVE OUT THE MANY, MANY SMALLER FIRMS
USING THE MINIMAX FOR ALL KINDS OF CLEANING &
DEGREASING, IN MANUFACTURING, REPAIRING AND PLANT
MAINTENANCE

**WEB SITES
FOR YOU TO
VISIT !**

VIRGINIA DEQ:
P2/MINI-MAX CLEANER
[www.deq.state.va.us/opp/p2va/
10arma.html](http://www.deq.state.va.us/opp/p2va/10arma.html)

PORTABLE STEAM CLEANING
SYSTEM (MINI-MAX)
[enviro.nfesc.navy.mil/
p2library/11-7_497.html](http://enviro.nfesc.navy.mil/p2library/11-7_497.html)

P2 MESSAGE (FASTT) U.S.N.:

P-2 POLLUTION OPPORTUNITY IDENTIFIED:
MINI-MAX SYSTEM REPLACES SOLVENT CLEANING AND
DEGREASING. THE TECHNOLOGY USES DISTILLED WATER.
COMPARED TO CURRENT CLEANING PROCEDURES THIS
TECHNOLOGY SAVES LABOR AND ASSOCIATED COSTS.
STUDY:: SUBBASE BANGOR: THIS TECHNOLOGY REDUCES
TIME TO CLEAN CIRCUIT BOARDS BY 90 HRS A MONTH,
ESTIMATED SAVINGS 9K A YR. UNIT PAID FOR ITSELF IN 6
MOS.

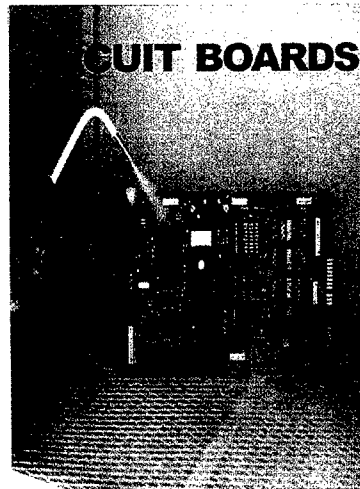
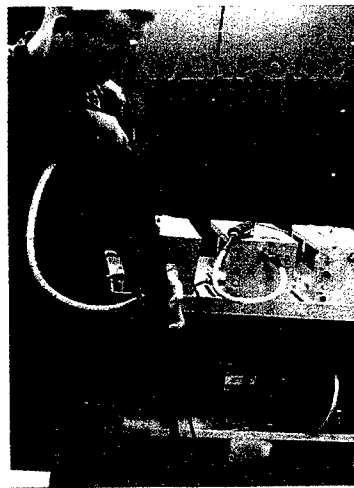
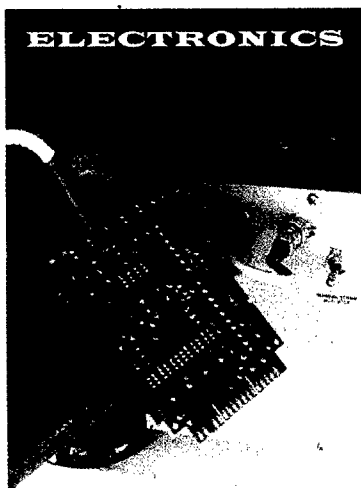
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15

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PRECISION INC.

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PHONE: (619) 581-6370
FAX: (619) 575-4067
PLANT: (619) 575-7155
www.minimaxcleaner.com
pdq@minimaxcleaner.com

**P.O. BOX 99838
SAN DIEGO, CA 92169**

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APPENDIX B
SAFE REPORT OF STEAM VAPOR CLEANING EGRESS SYSTEMS

MAINTENANCE & CLEANING OF US NAVY ESCAPE SYSTEMS USING SUPERHEATED-STEAM GENERATING SYSTEMS

Andrew C. Herring
Logistics Management Specialist
Aircrew Escape System Fleet Support Team
NAVAIR Depot Cherry Point, NC

ABSTRACT

The current method of cleaning aircraft ejection seats consists of applying an organic solvent or isopropyl alcohol by brush or low lint cloth. This method of cleaning the ejection seat/ or ejection seat components is extremely labor-intensive and generates significant quantities of cleaning residue. This residue must be disposed-of as HAZ-MAT.

Each year, our naval industrial base is further restricted from using specific Ozone Depleting Substances, in the cleaning of aircraft parts. As a result, less effective means of cleaning components are usually implemented.

The Aircrew Escape Systems Fleet Support Team (AESFST) has procured five models of a special portable steam cleaning system (figure 1), for evaluation. The use of steam is to eliminate or greatly reduce the use of organic solvents and isopropyl alcohol, as well as man-hours in the cleaning of naval ejection seats/ components. These five models show potential, from other steam cleaning systems, due to their portability and the steam pressures they produce. Their pressure production ranges from 190 to 300psi. This system uses distilled or de-ionized water as a cleaning solution to generate steam at a temperature of 500 degrees Fahrenheit.

The attractiveness of this system, to the AESFST, is that with this high temperature steam, the item being cleaned becomes virtually dry after steam spray is removed.

The evaluation is being performed by the Fleet maintainers at: MCAS Miramar; MCAS Beaufort; NAS North Island; NAS Oceana, NAS Kingsville and by NAVAIR Depots North Island and Jacksonville.

The evaluation is underway and the key factor of moisture intrusion will determine what seats/components (if any) are cleared for this type of cleaning.

The AESFST submitted an article, on our evaluation of the Mini-Max cleaning and waste management system, to the Navy Environmental News, magazine (Currents), which publishes new ideas and trends in environmental policy and compliance. The evaluation was featured in the winter, 2001 edition.

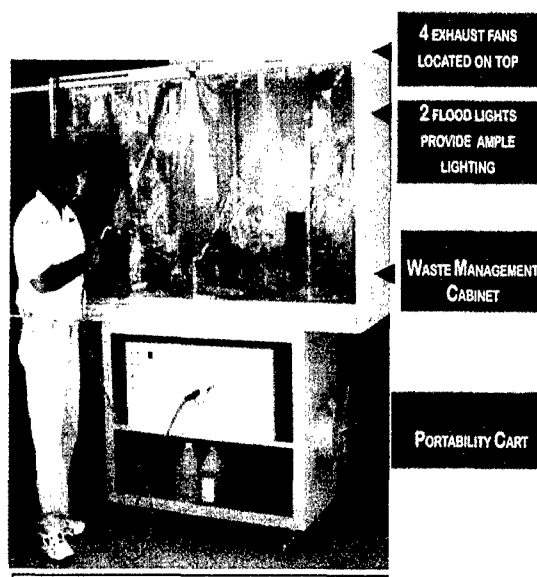


Figure 1. Jumbo Model

INTRODUCTION

The evaluation of steam cleaning ejection seats and/or their components was an idea conceived while trying to find ways of saving money, in Aircrew Systems. The US Navy has a program called "Affordable Readiness " in which any program/platform may submit cost saving initiatives that will reap a cost savings over a ten year period. Only the highest saving and most beneficial initiatives are approved. This initiative is being sponsored, by the Program Manager, PMA-202, Naval Air Systems Command. It should be understood that this evaluation is to determine which seats and components can be cleaned by Organizational and Intermediate Levels of maintenance. (Figure 2)



Figure 2: Marine from MCAS Miramar, after cleaning ejection seat component, using steam.

Since these two levels of maintenance, perform limited repair, water intrusion would cause the component to require complete overhaul. This moisture could promote corrosion and eventual malfunction. The Depot level can clean any component, which is scheduled to be overhauled/disassembled. We intend to perform cleaning tests on the components suitable, to evaluate the cleaning ability of the system, man-hours saved, portability, as well as, the quantity of Haz-Mat reduced or eliminated. This will aid us in deriving the cost savings realized.

METHOD

All research and investigation will be performed by the Aircrew Escape Systems Fleet Support Team Detachments at NADEPs Cherry Point, North Island and Jacksonville, with technical assistance from the NADEP North Island Materials Engineering Laboratory personnel. Organizational and Intermediate level testing, of the steam cleaning equipment, will be accomplished at MCAS Miramar, NAS NORIS Squadrons and AIMD as well as NAS Whidbey Island's AIMD, NAS Kingsville (Contractor maintained), NAS Oceana, MCAS Beaufort. Response sheets will be collected weekly from each site performing the evaluation. The data collected on these response sheets will reflect the performance of the equipment, quantities of material and man-hours required versus quantities required using normal cleaning methods. Upon completion of the evaluations (if the benefits are proven and the safety and readiness of the escape systems equipment are not compromised), the cleaning equipment showing the best results will be put into normal service at NADEPs NORIS, Jacksonville and benefiting squadrons.

DISCUSSION

The cleaning equipment being evaluated (Figure 3) is a patented, off-the-shelf technology, system that was originally developed to address instant sterilization and autoclave pre-cleaning, for the medical and dental professions. However, wider applications have been found in the military for cleaning everything from weapons to electronics. High temperature is maintained on the surface long enough for the steam to vaporize or liquidate the oil/grease, and displace the dirt. The residue, can effectively, be blown away, by the steam pressure, along with any steam condensation. The steam pressure production ranges from 190 to 300psi. This system uses distilled or de-ionized water as a cleaning solution, to generate steam at a temperature of 500 degrees Fahrenheit. The design of the steam producing equipment does not allow any steam to be stored under pressure, as in conventional steam boilers, thus providing a safe environment for the operator. The water content of the super-heated steam is low, with approximately one gallon of liquid water being needed for an 8-hour shift of continuous use. As a precautionary effort against flash surface oxidation, we will be applying a proprietary oxidation inhibitor, which is non-toxic, non-flammable and biodegradable, in conjunction with the steam. We will be testing this oxidation inhibitor to see how long the prevention lasts and to what degree.

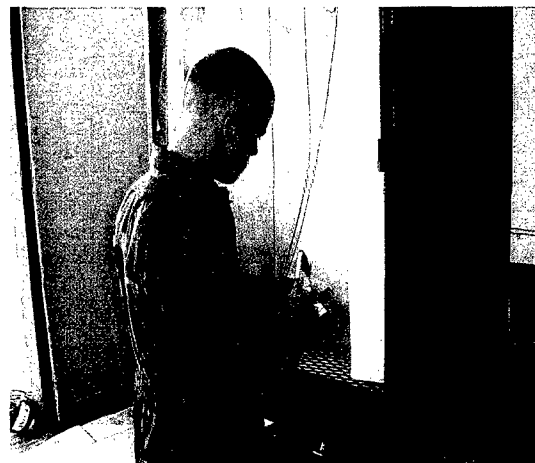


Figure 3: Evaluation of steam cleaning at Organizational Level of maintenance.

BIOGRAPHY

Andy Herring is employed by NAVAIRSYSCOM in the discipline of fleet support logistics. Mr. Herring is currently aligned as a Logistics Element Manager of Supply serving the Aircrew Escape Systems Fleet Support Team at Cherry Point, NC. He is also the logistics manager of the SJU-5/A, 6/A, GRUEA-7, and GRU-7A ejection seats. Mr. Herring has 29 years aviation maintenance experience at the "D" level and 3 years at the "O" and "I" levels. He graduated from the Naval Aviation Depot Norfolk Apprentice School in 1971 and has served in many aspects of aircraft overhaul and management.

APPENDIX C
NORTH ISLAND TEST PLAN

NAVAIR DEPOT NORTH ISLAND **STEAM CLEANING EVALUATION TEST PLAN**

1. Steam cleaning evaluation will be performed with steam cleaners utilizing various pressures and capacities. The 4.6 Engineering Team will monitor the process with weekly feedback from North Island seat shop. The cleaning effectiveness systems will be evaluated along with cost and time savings.
2. Perform physical testing for water intrusion. Testing performed on various tapes to establish which tapes stand up to steam/water without losing physical adhesive properties with minimum of residue. This tape will be used to prevent steam/water intrusion at mating surface joints and small bores in component surfaces. Also validate integrity and effectiveness of plugged or sealed orifices against water intrusion.
3. Perform physical testing to ensure paint chipping, peeling, or softening does not occur during steam cleaning process.
4. Submit ejection seat components to the steam cleaning process, disassembly, and inspect process for cleanliness. Precautions will be in place to safeguard against trapped water. Inspect for presence of water intrusion will be carried out the component. If water intrusion is present, the component will immediately be disassembled and dried.
5. Laboratory testing of the component O-ring seals to verify the absence or presence of degradation from being subjected to heated temperatures during the steam cleaning process. Also verify that the solutions used in steam cleaning process are compatible with O-rings
6. Provide independent laboratory testing of effectiveness of the Arma-Sol solution in providing rust inhibiting protection. Testing will also verify whether Arma-Sol is effective and superior to using distilled water only or existing rust preventative solutions. The evaluation will be performed as follows:
 - a. Immerse one freshly sandblasted bare steel panel for a 2.5-minute exposure in the diluted Arma-Sol Dry maintained at 200 deg. F. The panel is a 4"X6" steel sheet (4130 steel) and will be immersed in a 2000 ml. beaker filled to 2000 ml of the solution. After immersion the sample would be lifted out (using weld wire hook already pre-attached) and hung to dry in a different area.
 - b. A second panel would be exposed for 2.5 minutes in the Arma-Sol Wash (properly diluted and again at 200 deg. F.) then moved to the Arma-Sol Dry beaker for a 2.5-minute exposure. Document of any noticeable corrosion will be achieved by using a digital camera photographing the specimen at 30 minutes, 1 hour, 6 hours and 24 hours after removing panel from solution.

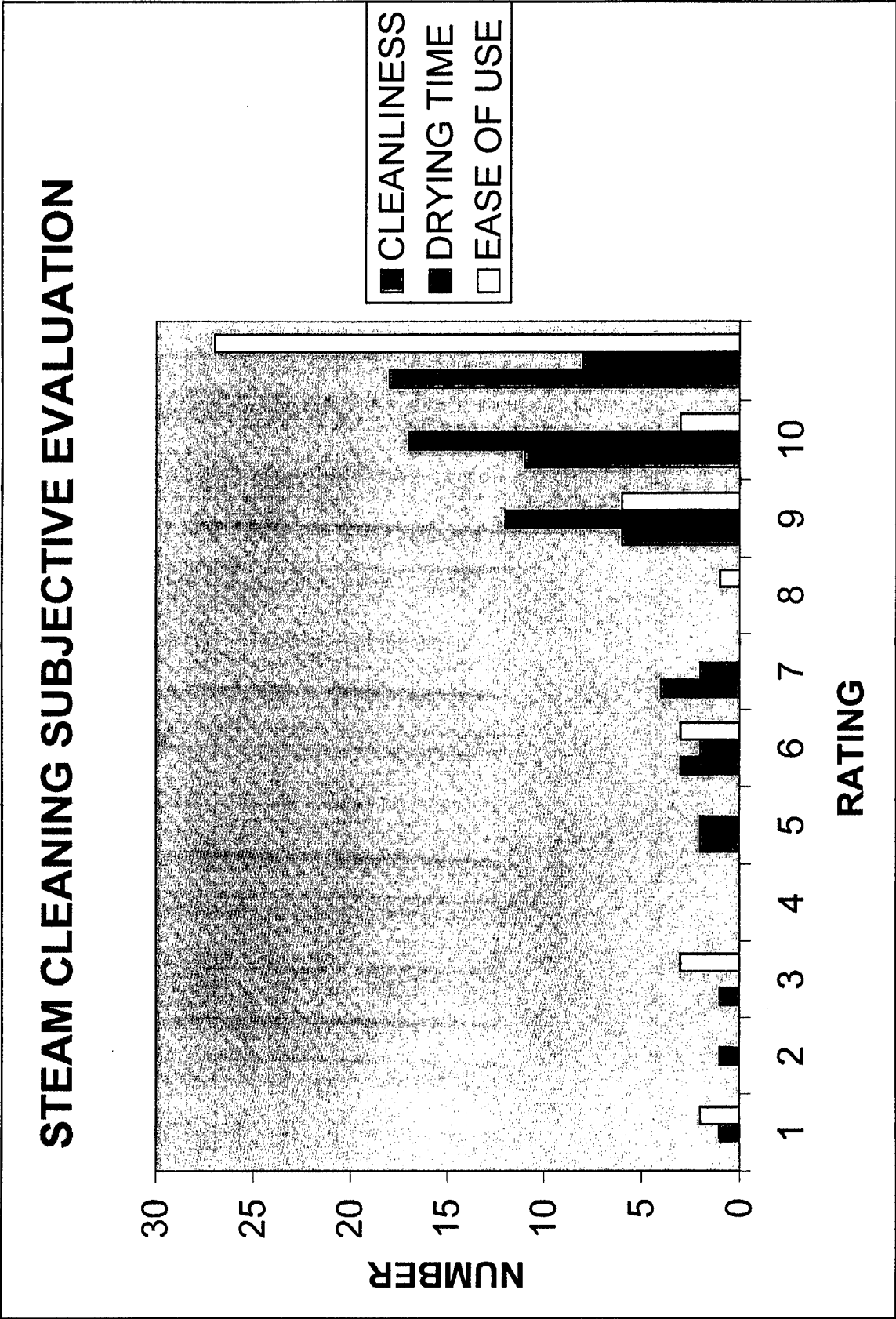
c. As a control for our experiment, a second phase of testing would use two other identically treated panels but expose them for 1 minute in one of two 2000ml beakers again filled to 2000 ml. One would have only DI (distilled / deionized) water and the second would have DI water with a standard rust inhibitor (Turco Rust Bloc) our cleaning shop uses. Both solutions would be at 160 deg. F. The drying and documentation procedure described above would be repeated.

Conclusions from the lab : I have finished the brief test and both the Arma-Sol and the Turco Rust Bloc were effective in delaying corrosion. As might be expected, tests using very hot (200 deg. F. vs. 160 deg. F.) deionized water showed less corrosion with deionized water (no additives) if only from the fact that the hot steel tends to evaporate water faster.

7. Test plan to also include concurrent field testing at Naval Air Station Whidbey Island, Naval Aviation Depot Jacksonville, and USMC Miramar.

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APPENDIX D
STEAM VAPOR CLEANING EVALUATION REPORTS



USER NAME	ACTIVITY	ITEM	DATE	CLEANLINESS	DRYING TIME	EASE	TIME SAVINGS	USED SOLVENT	SAVED	COST USED	COST SAVED
DALE STARKEY	NADEP NORIS	SHOULDER REEL	5/2/2001				0	0	0.125		\$0.62
MGNURLAN	NADEP NORIS	DROUGE GUNS	5/10/2001				0	1.25		\$4.74	
CROWE	NADEP NORIS	MBEU69541	5/11/2001				0		0		\$0.00
LARA	NADEP NORIS	SEAT	5/15/2001				30	0.25		\$0.95	
LARA	NADEP NORIS	S-3 SEAT PART	5/15/2001				60	0.5	0	\$1.90	\$0.00
CROWE	NADEP NORIS	MBEU69541	5/11/2001				0		0		
WALT FRASIER	NADEP NORIS	S-3 I-REEL	5/21/2001				10				
WALT FRASIER	NADEP NORIS	S-3 I-REEL	5/21/2001				10				
WALT FRASIER	NADEP NORIS	MBU 200-603	6/6/2001				0		1		\$4.97
DAN HICKS	NADEP NORIS	D115088-1&2	6/7/2001				1	1	1	\$3.79	\$4.97
DAN HICKS	NADEP NORIS	D115096-1	6/7/2001				0	1	1	\$3.79	\$4.97
WALT FRASIER	NADEP NORIS	MISC. COMP.	7/12/2001				60				
WALT FRASIER	NADEP NORIS	MISC. COMP.	7/13/2001				60				
WALT FRASIER	NADEP NORIS	MISC. COMP.	7/13/2001				60				
WALT FRASIER	NADEP NORIS	MISC. COMP.	7/24/2001				60				
WALT FRASIER	NADEP NORIS	MISC. COMP.	7/24/2001				60				
ALVIN KOEHLER	NADEP NORIS	NACES PITOT	8/6/2001				9	0.0156	0.031	\$0.06	\$0.15
ALVIN KOEHLER	NADEP NORIS	IMP	8/6/2001				9	0.0078	0.031	\$0.03	\$0.15
ALVIN KOEHLER	NADEP NORIS	EGI	8/6/2001				9	0.0078	0.0156	\$0.03	\$0.08
ALVIN KOEHLER	NADEP NORIS	BRU	8/6/2001				9	0.0078	0.0156	\$0.03	\$0.08
HAMLEY	WHIDBEY AIMD	HAND TOOLS	8/14/2001				120	0.25	0.75	\$0.95	\$5.11
BELLIS	WHIDBEY AIMD	HAND TOOLS	8/15/2001				120	0.25	0.75	\$0.95	\$5.11
KRAFT	WHIDBEY AIMD	PILOT SEAT	8/20/2001				120	0.25	0.75	\$0.95	\$5.11
HAMLEY	WHIDBEY AIMD	ECMO-1 SEAT	8/20/2001				60	0.25	0.75	\$0.95	\$3.26
JACKSON	WHIDBEY AIMD	ECMO-2 SEAT	8/20/2001				60	0.25	0.75	\$0.95	\$3.26
BELLIS	WHIDBEY AIMD	ECMO-3 SEAT	8/20/2001				60	0.25	0.75	\$0.95	\$3.26
TRUMAN	NADEP JAX	MB300-765	11/19/2001				2	0.17			
TRUMAN	NADEP JAX	CHUTE PLATE	11/19/2001				2	0.17			
TRUMAN	NADEP JAX	BACKET MRI	11/19/2001				3	0.17			
TRUMAN	NADEP JAX	GUILL BREECH	11/20/2001				5	0.17			
TRUMAN	NADEP JAX	GUILL LOTINE	11/20/2001				15	0.17			
TRUMAN	NADEP JAX	SHACKLE	11/20/2001				20	0.17			
TRUMAN	NADEP JAX	MB300-765	11/20/2001				2	0.17			
TRUMAN	NADEP JAX	CHUTE PLATE	11/20/2001				2	0.17			
TRUMAN	NADEP JAX	BACKET MRI	11/21/2001				3	0.17			
TRUMAN	NADEP JAX	GUILL BREECH	11/21/2001				5	0.17			
TRUMAN	NADEP JAX	GUILL LOTINE	11/21/2001				15	0.17			
TRUMAN	NADEP JAX	SHACKLE	11/21/2001				20	0.17			
TRUMAN	NADEP JAX	HRT PARTS	11/26/2001				40	0.17			
TRUMAN	NADEP JAX	TRM	11/26/2001				25	0.17			
TRUMAN	NADEP JAX	DROUGUE GUN	11/27/2001				10	0.17			
TRUMAN	NADEP JAX	RMI	11/27/2001				5	0.17			
TRUMAN	NADEP JAX	GUILL LOTINE	11/27/2001				10	0.17			
TRUMAN	NADEP JAX	FIRING HOOD	11/27/2001				5	0.17			

SEAT TYPE/POSITION GRU-7 Components SEAT SERIAL NUMBER

[illegible]

SEAT TYPE/POSITION Components SEAT SERIAL NUMBER[illegible]

SEAT TYPE/POSITION SJU-5/6 Components SEAT SERIAL NUMBER

[illegible]

SEAT TYPE/POSITION S-3 Components SEAT SERIAL NUMBER

[illegible]

SEAT SERIAL NUMBER

SEAT TYPE/POSITION S-3 Components

[illegible]

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

WARNING:

WARNING: Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.

SEAT TYPE/POSITION GRUEA7 ECMO2 SEAT SERIAL NUMBER

[illegible]

PORTABLE STEAM CLEANING SYSTEM DEPOT LEVEL EVALUATION SURVEY

SEAT TYPE/POSITION S-3B; STAPACS SEAT SERIAL NUMBER DEC148, DEC304, DEC396, DEC021

[illegible]

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".
WARNING:

WARNING: Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.

SEAT TYPE/POSITION S-3 and GRUEA7 Components

APPENDIX D

SEAT TYPE/POSITION Components SEAT SERIAL NUMBER[illegible]

User Name & Depot	Item Cleaned & Part Number	Date	Clean Rating * 10 Best 0 Worst	Drying Time 10 Best 0 Worst	Ease of Use * 10 Best 0 Worst	Time Savings Minutes	Gallons of Water Used Solvent Saved	Cost of Water Used Solvent Saved	Type of Steam Cleaner Used and Comments
Hamley AIMD WI 800 Div	Hand-tools Toolbox -1	8/14/01	9	8	9	2 hrs	¼ gal 3 qts		MINI-MAX MOD II
Hamley AIMD WI 800 Div	Hand-tools Toolbox -5	8/15/01	9	8	9	2 hrs	¼ gal 3 qts		
Bellis AIMD WI 800 Div	Hand-tools Toolbox -3	8/15/01	9	8	9	2 hrs	¼ gal 3 qts		
Kraft AIMD WI 800 Div	Pilot Seat GRUEA7 -1	8/20/01	9	9	10	1 hr	¼ gal 3 qts		Did not use on in closed items: TDM, TRM, Drogue Gun, Parachute Lock etc
Hamley AIMD WI 800 Div	ECMO-1 Seat GRUEA7 -2	8/20/01	10	9	10	1 hr	¼ gal 3 qts		
Jackson AIMD WI 800 Div	ECMO-2 Seat GRUEA7 -4	8/20/01	10	9	10	1 hr	¼ gal 3 qts		
Bellis AIMD WI 800 Div	ECMO-3 Seat GRUEA7 -3	8/20/01	10	9	10	1 hr	¼ gal 3 qts		

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

WARNING:

Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.

SEAT TYPE/POSITION GRUEA7 Components SEAT SERIAL NUMBER

[illegible]

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

WARNING:

WARNING: Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pilot tubes etc.

SEAT TYPE/POSITION GRUEA7 Components SEAT SERIAL NUMBER

User Name & Depot	Item Cleaned & Part Number	Date	Clean Rating *	Drying Time 10 Best 0 Worst	Ease of Use * 10 Best 0 Worst	Time Savings Minutes	Gallons of		Cost of		Type of Steam Cleaner Used and Comments
							Water Used	Solvent Saved	Water Used	Solvent Saved	
Truman AIMD WI	MBB300-765	11/20/01	10	10	10	2	1/5 gal				
Truman AIMD WI	Parachute Plate MB300-283	11/20/01	10	10	10	2	1/5 gal				
Truman AIMD WI	Bracket MRI MB300-1209	11/21/01	10	10	10	3	1/5 gal				
Truman AIMD WI	Guillotine Breech MB300-489	11/21/01	10	9	10	5	1/5 gal				
Truman AIMD WI	Guillotine MB200-438	11/21/01	10	9	10	15	1/5 gal				
Truman AIMD WI	Shackle MB200-562	11/21/01	10	10	10	20	1 gal				

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".
WARNING:
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.

[illegible][illegible]

NADEP NORIS MINI-MAX STEAM CLEANING COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01

ARTISAN: Dale Starkey

NOMENCLATURE: Pitot

PART NUMBER: MBEU146230

SERIAL NUMBER: 0118

EXTERNAL CLEANLINESS:

PRE-DISASSEMBLY
TEST RESULTS:

ACTUAL N/A REQUIRED LIMIT _____ PASSED _____ /FAILED _____

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS _____ EXTRA FIRM X NORMAL _____ RUNNY _____

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS _____ DRIED/HARD OUT _____ NORMAL _____

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE X NO MOISTURE EXHIBITED _____

COMMENTS:

1. Static port screen exhibited extensive moisture.
2. Upper and lower pistons did not exhibit moisture.
3. Interior of pitot arm appeared dry.
4. Inlet chambers were dry.

NADEP NORIS MINI-MAX STEAM CLEANING COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01

ARTISAN: Dale Starkey

NOMENCLATURE: Catapult Manifold Valve

PART NUMBER: MBEU147780

SERIAL NUMBER: DG 6261

EXTERNAL CLEANLINESS: Very Clean

**PRE-DISASSEMBLY
TEST RESULTS:**

ACTUAL N/A **REQUIRED LIMIT** _____ **PASSED** _____ **/FAILED** _____

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS _____ **EXTRA FIRM** _____ **NORMAL** _____ **RUNNY** _____

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS _____ **DRIED/HARD OUT** _____ **NORMAL** _____

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE X _____ **NO MOISTURE EXHIBITED** _____

COMMENTS:

1. Exhibited moisture at inlet connector (cartridge) bore.
2. Exhibited moisture in quick release pin bore.

NADEP NORIS MINI-MAX STEAM CLEANING COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01

ARTISAN: Dale Starkey

NOMENCLATURE: Barostatic Release Unit (BRU)

PART NUMBER: MBEU146265

SERIAL NUMBER: DH 0335

EXTERNAL CLEANLINESS: Very Clean

PRE-DISASSEMBLY
TEST RESULTS:

ACTUAL N/A REQUIRED LIMIT _____ PASSED _____ /FAILED _____

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS _____ EXTRA FIRM _____ NORMAL X RUNNY _____

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS X DRIED/HARD OUT _____ NORMAL X

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE X NO MOISTURE EXHIBITED _____

COMMENTS:

1. Traces of moisture under tape.
2. Release piston and chamber were wet
3. Firing pin assy and gears/pinions were dry.
4. Plugged cartridge chamber exhibited lots of moisture indside.
5. Parts exhibited light lubrication.
6. Moisture was present inside pipe
assy MBEU147432.

NADEP NORIS MINI-MAX STEAM CLEANING COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01

ARTISAN: Dale Starkey

NOMENCLATURE: Multi-Purpose Initiator (IMP)

PART NUMBER: MBEU145713

SERIAL NUMBER: DH 1271

EXTERNAL CLEANLINESS: Very Clean

PRE-DISASSEMBLY TEST RESULTS:

ACTUAL N/A REQUIRED LIMIT _____ PASSED / FAILED

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS NO EXTRA FIRM _____ NORMAL X RUNNY _____

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS NO DRIED/HARD OUT _____ NORMAL X _____

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE _____ NO MOISTURE EXHIBITED X _____

COMMENTS:

1. Cable cylinder was dry.
2. Bridle piston exhibited no moisture and was well lubed.
3. Start switches were dry.
4. Connector compartment was dry.

APPENDIX E
WHIDBEY ISLAND AIMD VISIT REPORT

Kwan, Ray

From: Kwan, Ray
Sent: Thursday, August 23, 2001 10:01 AM
To: Herring, Andrew C
Cc: Yost, Al
Subject: Whidbey Island Visit

Hi Andy,

I just got back from Whidbey Island last night. I'm still drying out, it never stopped raining during my entire trip! I visited the Paraloft AIMD on Tuesday afternoon with AME1 Mayard and AME2 Bellis, and on Wednesday morning I finally meet with Roger Grimes who just came back from a two week vacation.

We discussed the operation of the steam cleaner and cleaning techniques. The shop is aggressively using it to clean seats as authorized by our message. They have safeguards in place, taking care to not cleaning prohibited components. We discussed the use of tape to mask off areas we don't want to get wet. Blow drying is done to reduce drying time.

I explained the differences between Arma-Sol dry and wash, pre-mixed and concentrate solutions. About 100 bottles of Arma-sol concentrate solution and a few gallons of pre-mixed bottles are in the shop and I mentioned that it is available in the supply system. The shop is using approximately one gallon of Arma-Sol every day. They attach the pick-up line to a 5 gallon container which appears to be a more convenient than the one gallon bottles that we are using. Unfortunately the container is opaque, making reporting the amount of fluid used more difficult.



Their 295 dual chamber steam cleaner is on standby all day long. They turn it on every morning and don't shut it off between cleanings. The entire seat assembly is cleaned on the shop floor since it is too big for the spray booth. They are highly satisfied with the superior cleanliness and ease of use. Hand tools are also being effectively cleaned with the steam cleaner. The steam cleaner is dramatically reducing the amount of Toluene being used in the shop. Estimated reduction is from 50 gallons per year to 2 gallons per year.

The shop has a small portable single chamber 190 PSI steam cleaner. Due to its limitations, it is not being used, effectively terminating the evaluation of that unit. AME1 Mayard asked if it was possible to exchange that unit for a larger 295 PSI model similar to the one they currently have or a larger unit. Also, a second spray booth was delivered to the shop without the cart to place it onto. AME1 Mayard inquired about getting an additional cart. He mentioned that he talked to you about it. I told him that it may be possible to get the second unit after our ARI evaluation (possibly from one of the other activities that don't need/want theirs).

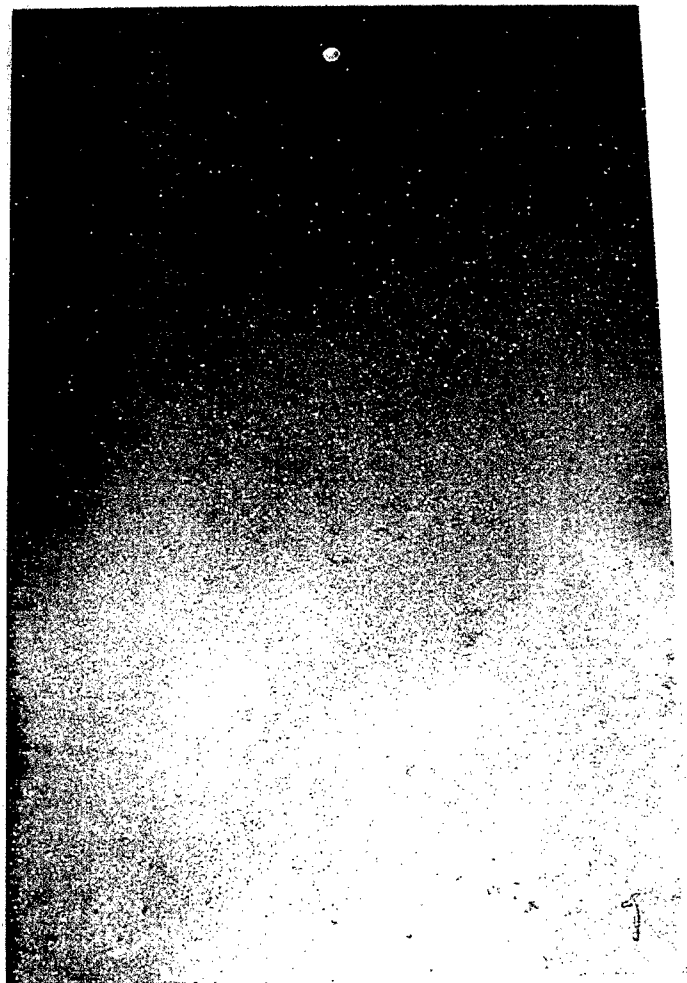
I emphasized the importance of documenting and reporting the use of the cleaner to our ARI effort. They will fill out the survey and fax it to Al Yost every week.

Ray

APPENDIX F
MATERIALS LABORATORY REPORT OF
CORROSION RESULTING FROM STEAM VAPOR CLEANING

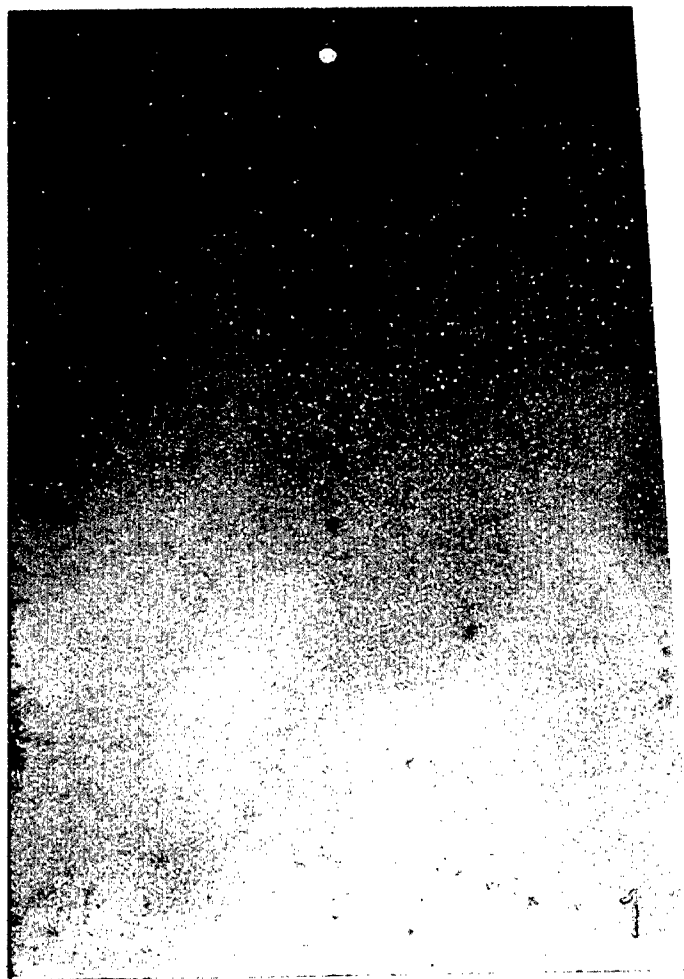
Analytical Report	
Requester A. Yost, Code 43520	Receipt Date 26 JUN 01
Control Number In House	Report Date 25 SEP 01
Reference Task Assignment	Report number ME-006-01
Sample Identification (Nomenclature, Part Number, Serial Number) Corrosion Test Panels in support of processing ejection seat hardware	
Parent Equipment (Aircraft/Engine Model No., BUNO) F/A-18	
<p>Five identical bare 4130 steel panels (4" X 6" X 0.062") were garnet blasted and then rinsed in alcohol. Each of the five was subjected to exposures in heated deionized water or heated deionized water with selected corrosion-inhibiting additives. After removing each panel from the heated 2000 ml. beaker(s), the progress of corrosion was documented after 10 minutes, one hour and 24 hours using a digital camera. Test panels were hung to dry after exposure in the Materials Engineering Laboratory at a convenient location near a wall.</p> <p>A 2 ounce sample of Arma-Sol's proprietary Wash and Arma_Sol's Dry concentrate were each added to separate gallons of deionized water. One coupon was immersed for 2.5 minutes in the Dry solution, a second for 2.5 minutes in deionized water and a third for 2.5 minutes in Arma-Sol Wash followed by 2.5 minutes in the Arma-Sol Dry solution. All solutions were kept at 195°F. - 205° F. Two other identically prepared steel test panels were immersed in heated deionized water heated to 160° F. for one minute except that one of the beakers of water had an addition of Turco's RustBloc (10% concentration).</p> <p>The two bare panels exposed to deionized water only had visible pitting after 10 minutes. The panel that was immersed in the 160° F. water had a band of pits along the lower edge where remaining water was held by surface tension. The panel exposed to 200° F. water did not retain any liquid water along its lower edge and therefor there was no band of pits at this location. The panels exposed to water solutions with additives (either RustBloc or the Arma-Sol additives) did not display pit initiation until the evaluation at 24 hours.</p> <p>Since these test panels were exposed (left to dry) to a somewhat "sheltered" laboratory environment, it would be prudent to use a factor of safety when comparing these test results to parts processed in the Depot cleaning Shops. Production parts have more access to the prevailing westerly winds carrying sea salt. An estimate of corrosion initiating within 12 hours, after exposure to deionized water with corrosion inhibiting additives, would seem reasonable.</p>	
ORIGINATOR E. Duffy 	

De-ionized Water
200° F. for 2.5 minutes

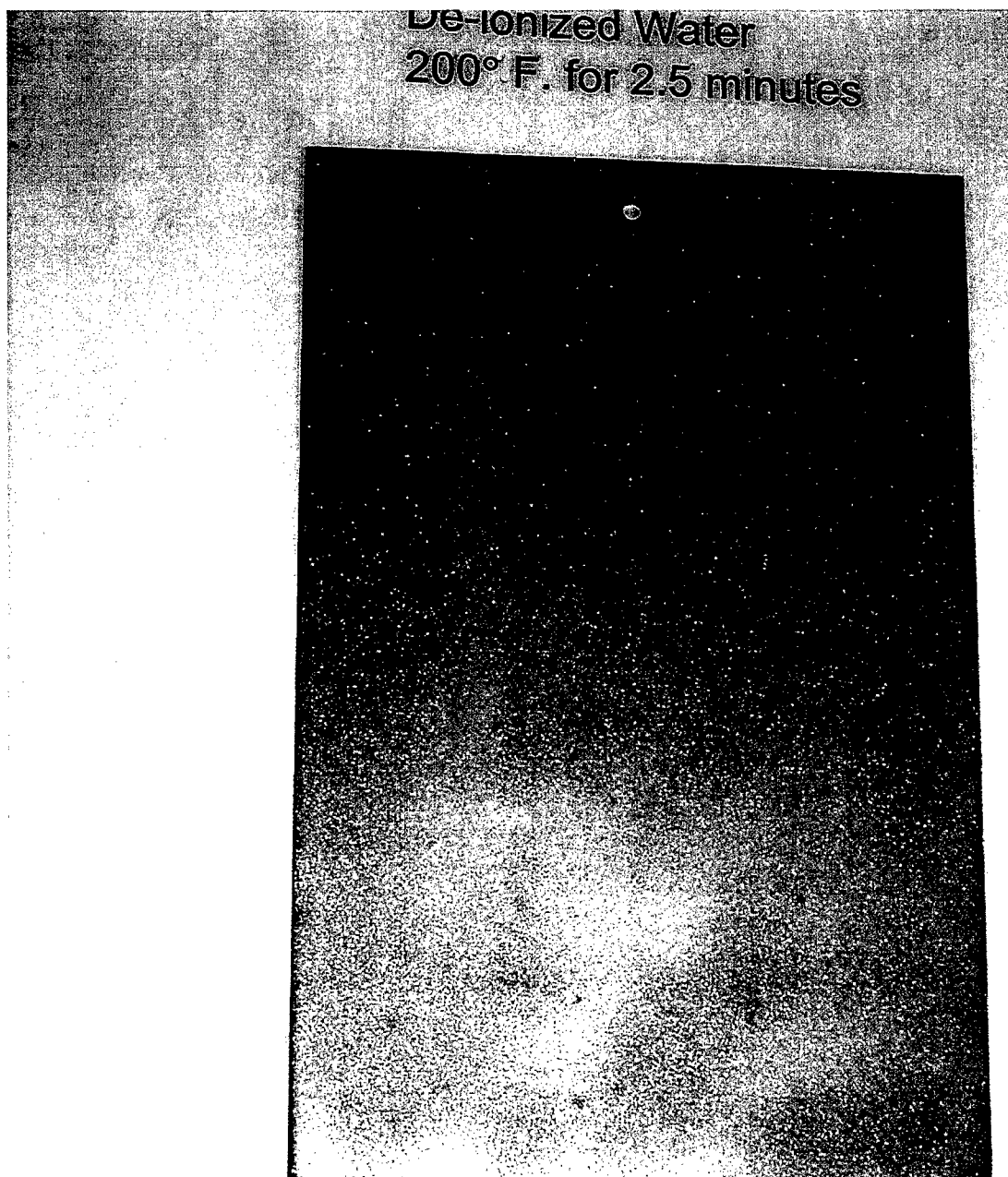


After 10 minutes

De-ionized Water
200° F. for 2.5 minutes

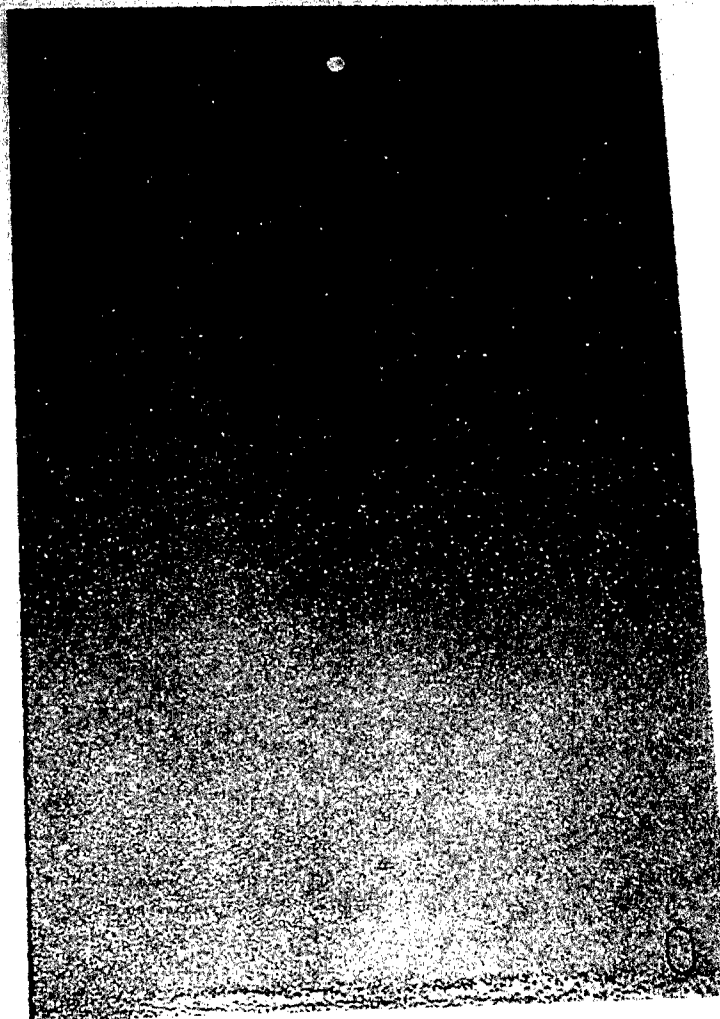


After 1 hour



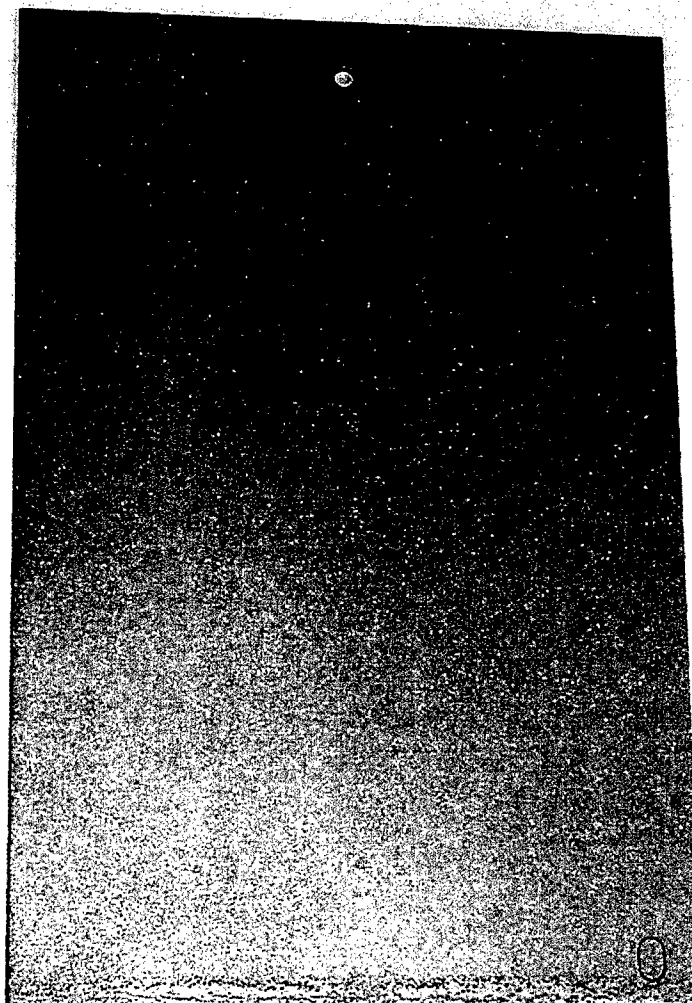
After 24 hours

Deionized Water
160° F. for 1 minute



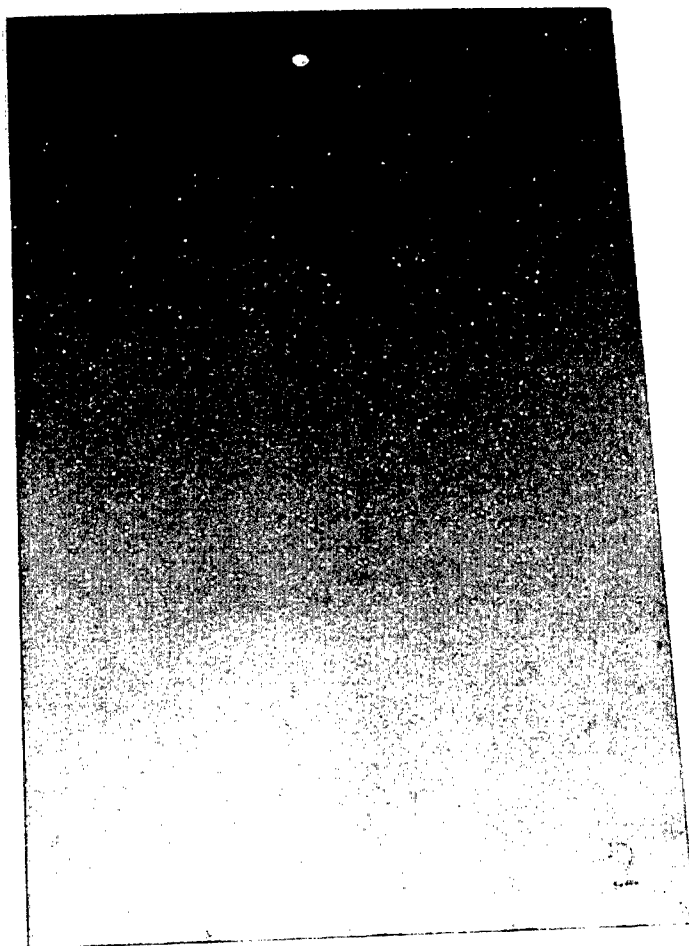
After 10 minutes

Deionized Water
160° F. for 1 minute

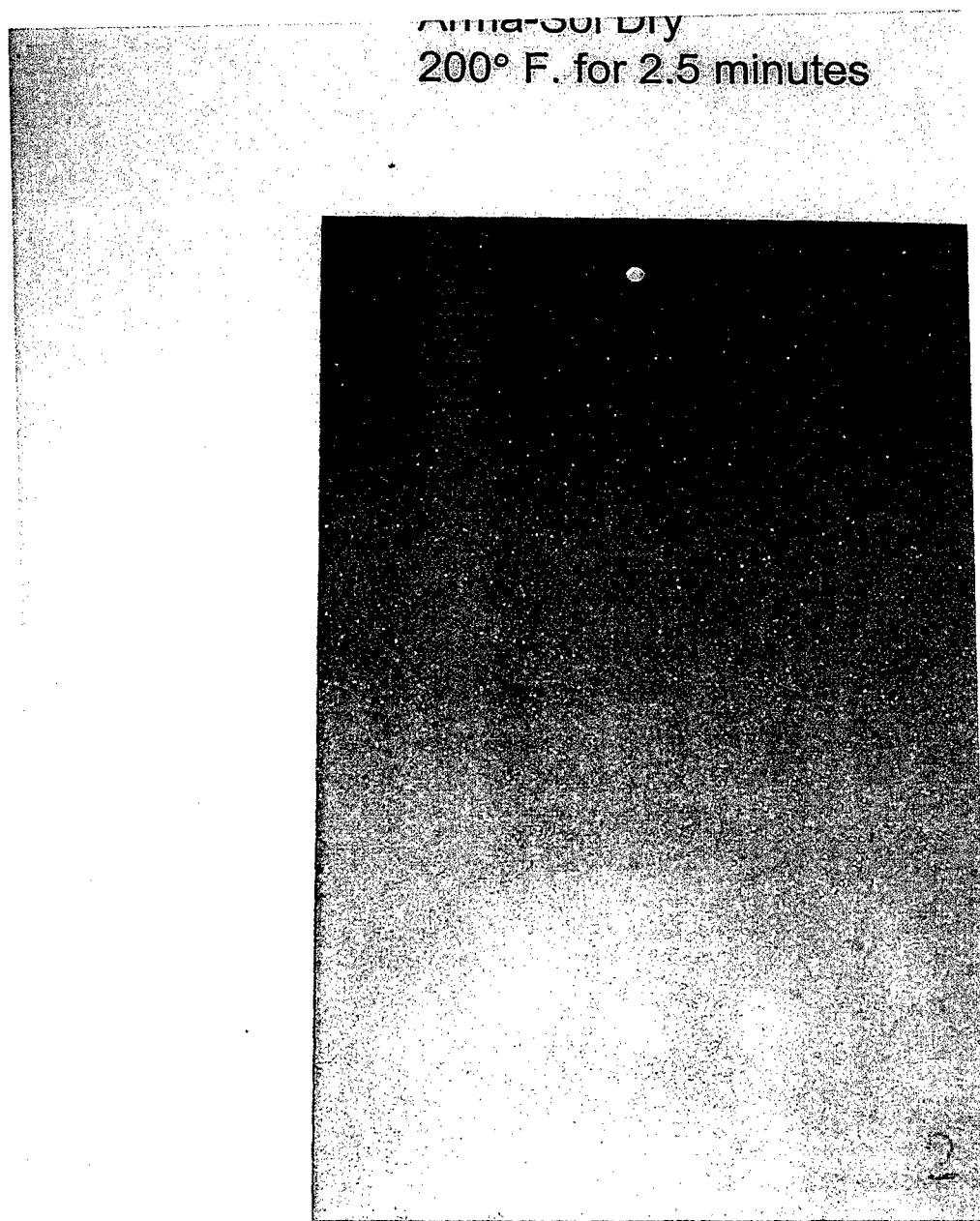


After 1 hour

Arma-Sol Dry
200° F. for 2.5 minutes

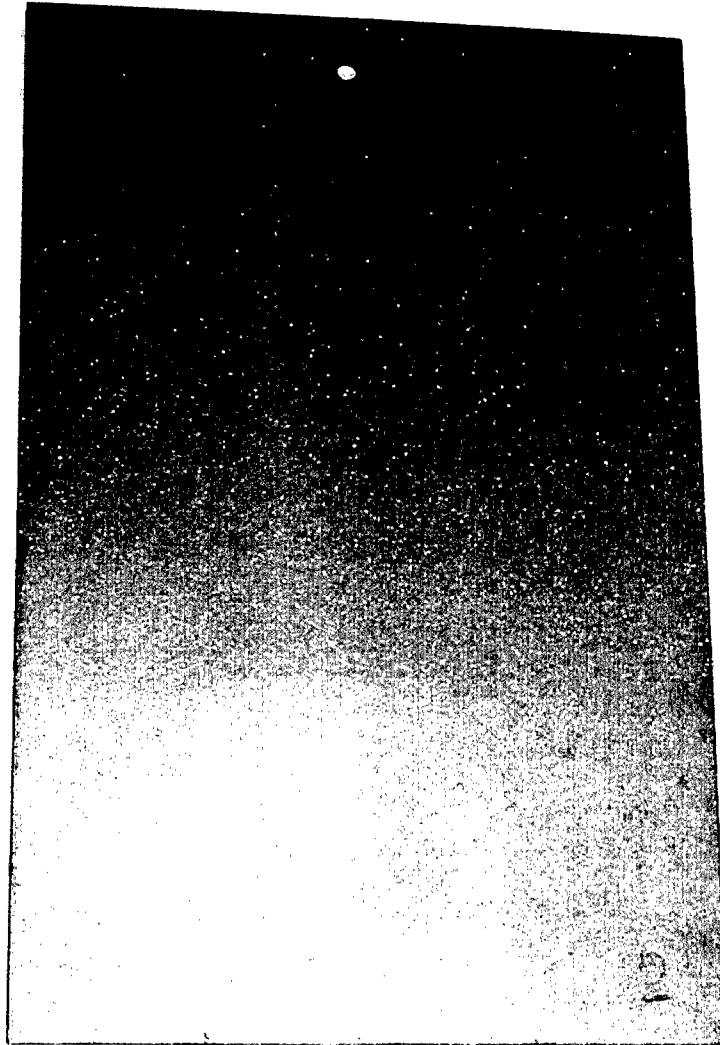


After 10 minutes



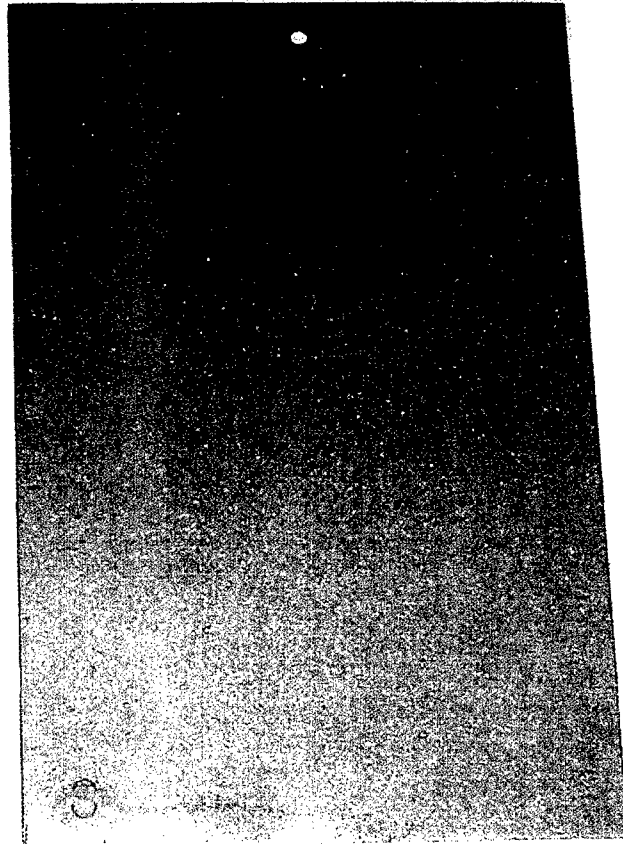
After 1 hour

Arma-Sol Dry
200° F. for 2.5 minutes



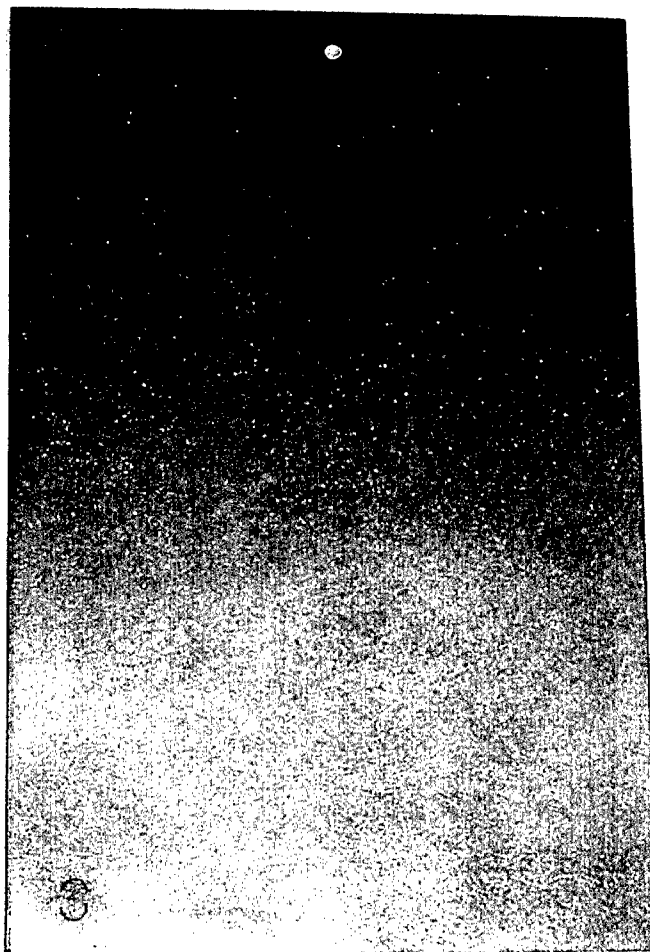
After 24 hours

Arma-Sol Wash
200° F. for 2.5 minutes
then Arma-Sol Dry
200° F. for 2.5 minutes



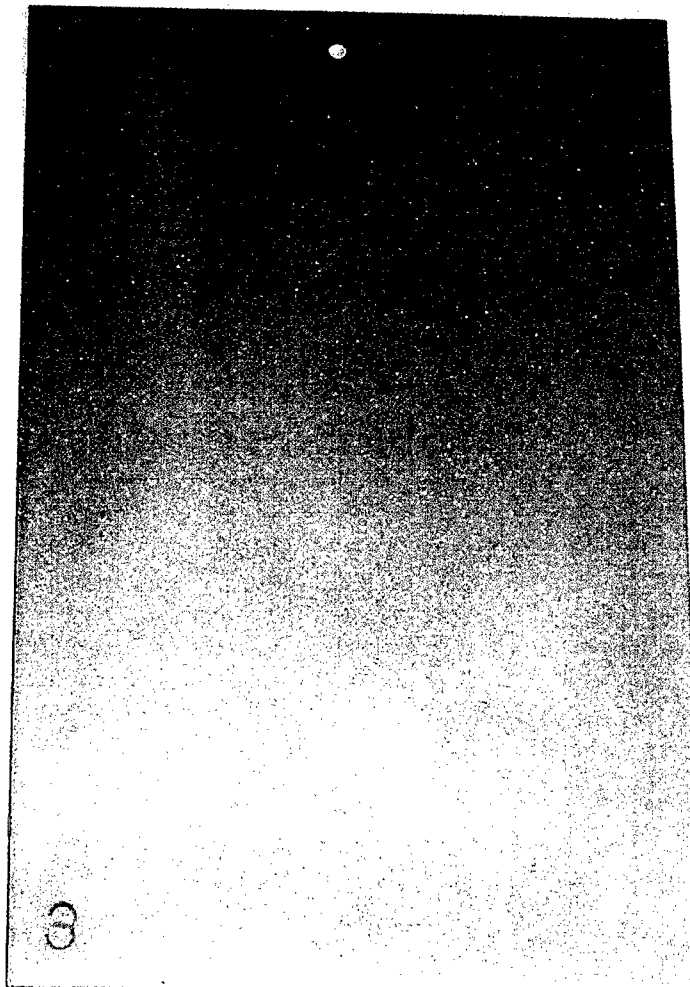
After 10 minutes

Arma-Sol Wash
200° F. for 2.5 minutes
then Arma-Sol Dry
200° F. for 2.5 minutes



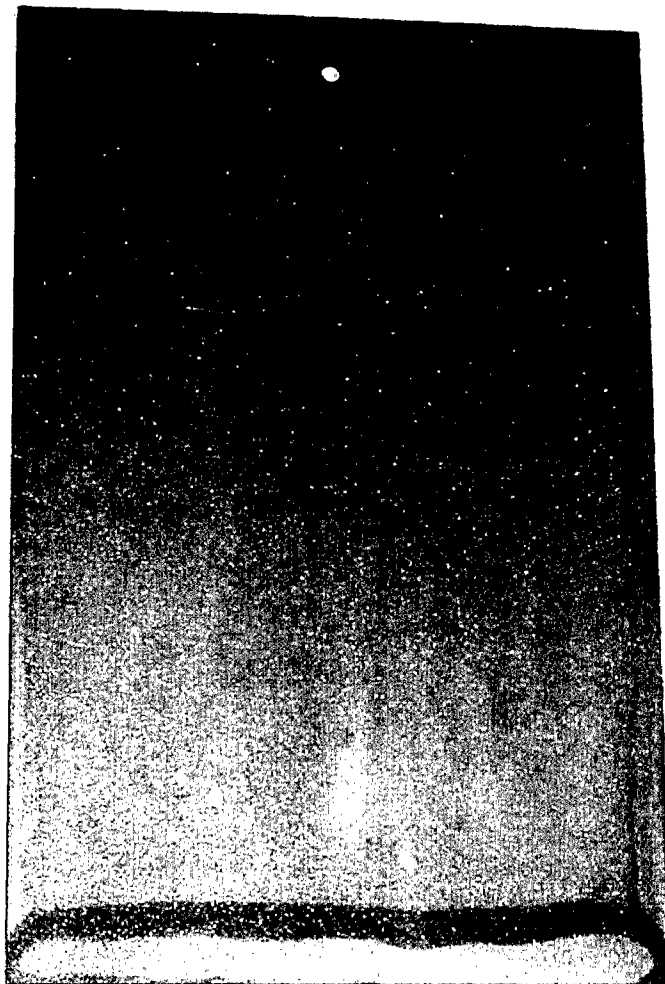
After 1 hour

Arma-Sol Wash
200° F. for 2.5 minutes
then Arma-Sol Dry
200° F. for 2.5 minutes



After 24 hours

Rust Bloc (1%)
160° F. for 1 minute



After 1 hour

Rust Bloc (1%)
160° F. for 1 minute



After 10 minutes

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APPENDIX G
MATERIALS LABORATORY REPORT OF
O-RING DETERIORATION FROM SUPER HEATED STEAM

MATERIAL ENGINEERING SERVICES REQUEST

(SUBMIT ORIGINAL AND ONE COPY)

FROM: (Shop/Activity/Location)	PHONE NO.	SUBMITTED BY	DATE
Air Vehicle Mechanical Engineering Branch (4.3.5)	542-0519, EXT 128	J. V. Santiago	24-Nov-01
TO:	JOB NO.	REQUIRED FOR	
MATERIALS ENGINEERING DIVISION, NAVAL AVIATION DEPOT NAVAL AIR STATION, JACKSONVILLE, FLORIDA 32212-0016	FAM5101	<input type="checkbox"/> EI <input type="checkbox"/> 1ST ART. <input checked="" type="checkbox"/> OTHER	
PART/SAMPLE NAME	<input checked="" type="checkbox"/> URGENT <input type="checkbox"/> ROUTINE	A/C MODEL & BU. NO.	
Use of Cleaning Systems (Steam-Vac) on Ejection Seats		Ejection Seat Components	
SERVICE DESIRED:			

1. A Steam-Vac (Mini max) machine is currently used in the seat shop to clean seat parts. The Steam-Vac machine provides an outlet temperature of 300 deg farenheit (right outside the probe). The probe is maintained a minimum of 1 inch away from the seat component.

2. Seat components use MS28775 and MS29513 series o-rings. According to the MS28775 and MS29513 spec, the max operating temperature allowed for the o-ring is 275 deg F.

3. This machine is also to be used by squadrons at the "O" level. The intent is to use this machine to clean seat components with o-rings installed inside the seat part. Lubricants like VV-L-800 are also used to lubricate internal areas of seat components.

Request Materials Lab assistance to determine if is safe to clean seat components with o-rings inside the part. The question is, Can Mini-Max be used on seat parts and the o-rings be safe for use.

Same question applies for the lubricants like VV-L-800.

4. Please call when MESR is ready.

4. Use Job nr FAM5101.

ATTACH & list all applicable correspondence (NARFJAXINST 4730.2 Series)

EI Control No.: None

REPLY

- Note:
- (1) MS28775 was canceled and superseded by SAE-AS28775 on 29 Sep 00. Material and dimensional requirements remain the same.
 - (2) MS29513 was canceled and superseded by SAE-AS29513 on 1 Mar 01. Material and dimensional requirements remain the same.
 - (3) The VV-L-800 specification was canceled and superseded by MIL-PRF-32033 on 24 Jul 00. Material requirements and physical properties remain the same.

1. Use of the Steam-Vac (Mini max) machine for cleaning ejection seats, under conditions as described in Paragraph 1, will not accelerate deterioration nor damage either o-ring.

2. The cleaning process will, however, remove any MIL-PRF-32033 lubricant exposed to the action of the machine. Required lubricant will need to be replaced after cleaning.

3. Point of contact: Mike Butts, 4.3.4.4, 542-3444 ext 123.

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ENGINEER	REVIEWED BY	APPROVED BY	DATE OUT	REQUEST NO.
<i>Mike Butts</i>	<i>WmJ</i>		1/11/02	02JX00034

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